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THE LAWS OF HABIT.

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WHEN we look at living creatures from an outward point of view, one of the first things that strike us is that they are bundles of habits. In wild animals, the usual round of daily behavior seems a necessity implanted at birth; in animals domesticated, and especially in man, it seems, to a great extent, to be the result of education. The habits to which there is an innate tendency are called instincts; some of those due to education would by most persons be called acts of reason. It thus appears that habit covers a very large part of life, and that one engaged in studying the objective manifestations of mind is bound at the very outset to define clearly just what its limits are.

The moment one tries to define what habit is, one is led to the fundamental properties of matter. The laws of Nature are nothing but the immutable habits which the different elementary sorts of matter follow in their actions and reactions upon each other. In the organic world, however, the habits are more variable than this. Even instincts vary from one individual to another of a kind; and are modified in the same individual, as we shall later see, to suit the exigencies of the case. The habits of an elementary particle of matter can not change (on the principles of the atomistic philosophy), because the particle is itself an unchangeable thing; but those of a compound mass of matter can change, because they are in the last instance due to the structure of the compound, and either outward forces or inward tensions can, from one hour to another, turn that structure into something different from what it was. That is, they can do so if the body be plastic enough to maintain its integrity, and be not disrupted when its structure yields. The change of structure here spoken of need not involve the outward shape; it may be invisible and molecular, as when a bar of iron becomes magnetic or crystalline through the action

of certain outward causes, or India-rubber becomes friable, or plaster "sets." All these changes are rather slow; the material in question opposes a certain resistance to the modifying cause, which it takes time to overcome, but the gradual yielding whereof often saves the material from being disintegrated altogether. When the structure has yielded, the same inertia becomes a condition of its comparative permanence in the new form, and of the new habits the body then manifests. *Plasticity*, then, in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once. Each relatively stable phase of equilibrium in such a structure is marked by what we may call a new set of habits. Organic matter, especially nervous tissue, seems endowed with a very extraordinary degree of plasticity of this sort; so that we may without hesitation lay down as our first proposition the following, that *the phenomena of habit in living beings are due to the plasticity* of the organic materials of which their bodies are composed.*

But the philosophy of habit is thus, in the first instance, a chapter in physics rather than in physiology or psychology. That it is at bottom a physical principle is admitted by all good recent writers on the subject. They call attention to analogues of acquired habits exhibited by dead matter. Thus, M. Léon Dumont, whose essay on habit is perhaps the most philosophical account yet published, writes: "Every one knows how a garment, after having been worn a certain time, clings to the shape of the body better than when it was new; there has been a change in the tissue, and this change is a new habit of cohesion. A lock works better after being used some time; at the outset more force was required to overcome certain roughnesses in the mechanism. The overcoming of their resistance is a phenomenon of habituation. It costs less trouble to fold a paper when it has been folded already. This saving of trouble is due to the essential nature of habit, which brings it about that, to reproduce the effect, a less amount of outward causality is required. The sounds of a violin improve by use in the hands of an able artist, because the fibers of the wood at last contract habits of vibration conformed to harmonic relations. This is what gives such inestimable value to instruments that have belonged to great masters. Water in flowing hollows out for itself a channel, which grows broader and deeper, and, after having ceased to flow, it resumes, when it flows again, the path traced by itself before. Just so, the impressions of outer objects fashion for themselves in the nervous system more and more appropriate paths, and these vital phenomena recur under similar excitements from without, when they have been interrupted a certain time."

Not in the nervous system alone. A scar anywhere is a *locus minoris resistentiæ*, more liable to be abraded, inflamed, to suffer

* In the sense above explained, which applies to molecular structure as well as to that of grosser parts.

pain and cold, than are the neighboring parts. A sprained ankle, a dislocated arm, are in danger of being sprained or dislocated again; joints that have once been attacked by rheumatism or gout, mucous membranes that have been the seat of catarrh, are with each fresh recurrence more prone to a relapse, until often the morbid state chronically substitutes itself for the sound one. And if we ascend to the nervous system, we find how many so-called functional diseases seem to keep themselves going simply because they happen to have once begun; and how the forcible cutting short by medicine of a few attacks is often sufficient to enable the physiological forces to get possession of the field again, and to bring the organs back to functions of health. Epilepsies, neuralgias, convulsive affections of various sorts, insomnias, are so many cases in point. And, to take what are more obviously habits, the success with which a "weaning" treatment can often be applied to the victims of unhealthy indulgence of passion, or of mere complaining or irascible disposition, shows us how much the morbid manifestations themselves were due to the mere inertia of the nervous organs, when once launched on a false career.

Can we now form a notion of what the inward physical changes may be like, in organs whose habits have thus struck into new paths? In other words, can we say just what mechanical facts the expression "change of habit" covers when it is applied to a nervous system? Certainly we can not in anything like a minute or definite way. But our usual scientific custom of interpreting hidden molecular events after the analogy of visible massive ones enables us to frame easily an abstract and general scheme of processes which the physical changes in question *may* be like. And when once the possibility of *some* kind of mechanical interpretation is established, Mechanical Science, in her present mood, will not hesitate to set her brand of ownership upon the matter, feeling sure that it is only a question of time when the exact mechanical explanation of the case shall be found out.

Of course, a simple habit, like every other nervous event—the habit of snuffling, for example, or of putting one's hands into one's pockets, or of biting one's nails—is, mechanically, nothing but a reflex discharge; and its anatomical substratum must be a reflex arc in the nervous system. The more complex habits, as we shall presently see more fully, are, from the same neural point of view, nothing but *concatenated* discharges in the nerve-centers, due to the presence there of systems of reflex arcs, so organized as to wake each other up successively—the impression produced by one muscular contraction serving as a stimulus to provoke the next, until a final impression inhibits the process and closes the chain. The mechanical problem, then, is to explain the formation *de novo* of a simple reflex arc in a pre-existing nervous system. Here, as in so many other cases, it is only the *premier pas qui coûte.* For a nervous system is nothing but a system of *paths* which the nerve-current follows, between a sensory *terminus a*

quo and a muscular, glandular, or other *terminus ad quem.* A path once traversed by a nerve-current might be expected to follow the law of most of the paths we know,* and to be scooped out and made more permeable than before; and this ought to be repeated with each new passage of the current. Whatever obstructions may have kept it at first from being a path, should then, little by little, and more and more, be swept out of the way, until at last it might become a natural drainage-channel. This is what happens where either solids or liquids pass over a path; there seems no reason why it should not happen where the thing that passes is not a moving body, but a mere wave of rearrangement in matter that does not displace itself in the line of the "path," but merely changes chemically or turns itself round in place, or vibrates across the line. The most plausible views of the nerve-current make it out to be the passage of some such wave of rearrangement as this. If only a part of the matter of the *path* were to "rearrange" itself, the neighboring parts remaining inert, it is easy to see how their inertness might oppose a friction which it would take many waves of rearrangement to break down and overcome. If we call the path itself the "organ," and the rearrangement of the molecules the "function," then it is obviously a case for repeating the celebrated French formula of "*La fonction fait l'organe.*"

So nothing is easier than to imagine how, when a current once has traversed a path, it should traverse it more readily still a second time. But what made it ever traverse it the first time?† In answering this question we can only fall back on our general conception of a nervous system as a mass of matter whose parts, constantly kept in states of different tension, are as constantly tending to equalize their states. The equalization between any two points occurs through whatever path may at the moment be most pervious. But, as a given point of the system may belong, actually or potentially, to many different paths, and, as the play of nutrition is subject to accidental changes, *blocks* may from time to time occur, and make currents shoot through unwonted lines. Such an unwonted line would be a new-created path, which, if traversed repeatedly, would become the beginning of a new reflex arc. All this is vague to the last degree, and amounts to little more than saying that a new path may be formed by the sort of *chances* that in nervous material are likely to occur. But, vague as it is, it is really the last word of our wisdom in the matter.‡

* Some paths, to be sure, are banked up by bodies moving through them under too great pressure, and made impervious. These special cases we disregard.

† We can not say *the will*, for, though many, perhaps most, human habits were once voluntary actions, no action can be *primarily* such. While an habitual action may once have been voluntary, the voluntary action must before that, at least once, have been impulsive or reflex. It is this very first occurrence of all that we consider in the text.

‡ Those who desire a more definite formulation may consult J. Fiske's "Cosmic Philosophy," vol. ii, pp. 142–146, and Spencer's "Principles of Biology," sections 302 and 303, and the part entitled "Physical Synthesis" of his "Principles of Psychology." Mr.

It must be noticed that the growth of structural modification in living matter may be more rapid than in any lifeless mass, because the incessant nutritive renovation of which the living matter is the seat, tends often to corroborate and fix the impressed modification, rather than to counteract it by renewing the original constitution of the tissue that has been impressed. Thus, we notice after exercising our muscles or our brain in a new way, that we can do so no longer at that time; but after a day or two of rest, when we resume the discipline, our increase in skill not seldom surprises us. This has led a German author to say that we learn to swim during the winter and to skate during the summer.

Dr. Carpenter writes:* "It is a matter of universal experience, that every kind of training for special aptitudes is both far more effective, and leaves a more permanent impress, when exerted on the *growing* organism, than when brought to bear on the adult. The effect of such training is shown in the tendency of the organ to 'grow to' the mode in which it is habitually exercised; as is evidenced by the increased size and power of particular sets of muscles, and the extraordinary flexibility of joints, which are acquired by such as have been early exercised in gymnastic performances. . . . There is no part of the organism of man in which the *reconstructive activity* is so great, during the whole period of life, as it is in the ganglionic substance of the brain. This is indicated by the enormous supply of blood which it receives. . . . It is, moreover, a fact of great significance that the nerve-substance is specially distinguished by its *reparative* power. For while injuries of other tissues (such as the muscular) which are distinguished by the *speciality* of their structure and endowments, are repaired by substance of a lower or less specialized type, those of nerve-substance are repaired by a complete reproduction of the normal tissue; as is evidenced in the sensibility of the newly forming skin which is closing over an open wound, or in the recovery of the sensibility of a piece of "transplanted" skin, which has for a time been rendered insensible by the complete interruption of the continuity of its nerves. The most remarkable example of this reproduction, however, is afforded by the results of M. Brown-Séquard's† experiments upon the gradual restoration of the functional activity of the spinal cord after its complete division; which takes place in a way that indicates rather a *reproduction* of the whole or the lower part of the cord and of the nerves proceeding from it, than a mere *reunion* of

Spencer there tries, not only to show how new actions may arise in nervous systems and form new reflex arcs therein, but even how nervous tissue may actually be born by the passage of new waves of isomeric transformation through an originally indifferent mass. I can not help thinking that Mr. Spencer's data, under a great appearance of precision, conceal lamentable vagueness and improbability, and even self-contradiction.

* "Mental Physiology," 1874, pp. 339–345.

† [See, later, Masius in Van Beneden's and Van Bambeke's "Archives de Biologie," vol. i, Liége, 1880.—W. J.]

divided surfaces. This reproduction is but a special manifestation of the reconstructive change which is *always* taking place in the nervous system; it being not less obvious to the eye of reason that the 'waste' occasioned by its functional activity must be constantly repaired by the production of new tissue, than it is to the eye of sense that such reparation supplies an actual *loss* of substance by disease or injury.

"Now, in this constant and active reconstruction of the nervous system, we recognize a most marked conformity to the general plan manifested in the nutrition of the organism as a whole. For, in the first place, it is obvious that there is a tendency to the production of a *determinate type* of structure; which type is often not merely that of the species, but some special modification of it which characterized one or both of the progenitors. But this type is peculiarly liable to modification during the early period of life; in which the functional activity of the nervous system (and particularly of the brain) is extraordinarily great, and the reconstructive process proportionally active. And this modifiability expresses itself in the formation of the mechanism by which those *secondarily automatic* modes of movement come to be established, which, in man, take the place of those that are *congenital* in most of the animals beneath him; and those modes of sense-perception come to be *acquired*, which are elsewhere clearly *instinctive*. For there can be no reasonable doubt that, in both cases, a nervous mechanism is *developed* in the course of this self-education, corresponding with that which the lower animals inherit from their parents. The *plan* of that *rebuilding* process, which is necessary to maintain the integrity of the organism generally, and which goes on with peculiar activity in this portion of it, is thus being incessantly modified; and in this manner all that portion of it which ministers to the *external* life of sense and motion that is shared by man with the animal kingdom at large, becomes at adult age the expression of the habits which the individual has acquired during the period of growth and development. Of these habits, some are common to the race generally, while others are peculiar to the individual; those of the former kind (such as walking erect) being universally acquired, save where physical inability prevents; while for the latter a special training is needed, which is usually the more effective the earlier it is begun—as is remarkably seen in the case of such feats of dexterity as require a conjoint education of the perceptive and of the motor powers. And when thus developed during the period of growth, so as to have become a part of the constitution of the adult, the acquired mechanism is thenceforth maintained in the ordinary course of the nutritive operations, so as to be ready for use when called upon, even after long inaction.

"What is so clearly true of the nervous apparatus of animal life, can scarcely be otherwise than true of that which ministers to the automatic activity of the mind. For, as already shown, the study of psychology has evolved no more certain result than that there are uniformi-

ties of mental action, which are so entirely conformable to those of bodily action as to indicate their intimate relation to a 'mechanism of thought and feeling,' acting under the like conditions with that of sense and motion. The psychical principles of *association*, indeed, and the physiological principles of *nutrition*, simply express—the former in terms of mind, the latter in terms of brain—the universally admitted fact that any sequence of mental action which has been frequently repeated tends to perpetuate itself; so that we find ourselves automatically prompted to *think*, *feel*, or *do* what we have been before accustomed to think, feel, or do, under like circumstances, without any consciously formed *purpose*, or anticipation of results. For there is no reason to regard the cerebrum as an exception to the general principle that, while each part of the organism tends to *form itself* in accordance with the mode in which it is habitually exercised, this tendency will be especially strong in the nervous apparatus, in virtue of that *incessant regeneration* which is the very condition of its functional activity. It scarcely, indeed, admits of doubt that every state of ideational consciousness which is either *very strong* or is *habitually repeated*, leaves an organic impression on the cerebrum; in virtue of which that same state may be reproduced at any future time, in respondence to a suggestion fitted to excite it. . . . The 'strength of early association' is a fact so universally recognized, that the expression of it has become proverbial; and this precisely accords with the physiological principle that, during the period of growth and development, the formative activity of the brain will be most amenable to directing influences. It is in this way that what is early 'learned by heart' becomes branded in (as it were) upon the cerebrum; so that its 'traces' are never lost, even though the conscious memory of it may have completely faded out. For, when the organic modification has been once *fixed* in the growing brain, it becomes a part of the normal fabric, and is regularly *maintained* by nutritive substitution; so that it may endure to the end of life, like the scar of a wound."

Dr. Carpenter's phrase, that *our nervous system grows to the modes in which it has been exercised* expresses the philosophy of habit in a nutshell. We may now trace some of the practical applications of the principle to human life.

The first result of it is that *habit simplifies the movements required to achieve a given result, makes them more accurate and diminishes fatigue.*

"The beginner at the piano not only moves his finger up and down in order to depress the key, he moves the whole hand, the forearm, and even the entire body, especially moving its least rigid part, the head, as if he would press down the key with that organ too. Often a contraction of the abdominal muscles occurs as well. Principally, however, the impulse is determined to the motion of the hand and of the single finger. This is, in the first place, because the move-

ment of the finger is the movement *thought of*, and in the second place because its movement and that of the key are the movements we try to *perceive*, along with the results of the latter on the ear. The more often the process is repeated, the easier the movement follows, on account of the increase in permeability of the nerves engaged.

"But the more easily the movement occurs, the slighter is the stimulus required to set it up; and the slighter the stimulus is, the more its effect is confined to the fingers alone.

"Thus, an impulse which originally spread its effects over the whole body, or at least over many of its movable parts, is gradually determined to a single definite organ, in which it effects the contraction of a few limited muscles. In this change the thoughts and perceptions which start the impulse acquire more and more intimate causal relations with a particular group of motor nerves.

"To recur to a simile, at least partially apt, imagine the nervous system to represent a drainage-system, inclining, on the whole, toward certain muscles, but with the escape thither somewhat clogged. Then streams of water will, on the whole, tend most to fill the drains that go toward these muscles and to wash out the escape. In case of a sudden 'flushing,' however, the whole system of channels will fill itself, and the water overflow everywhere before it escapes. But a moderate quantity of water invading the system will flow through the proper escape alone.

"Just so with the piano-player. As soon as his impulse, which has gradually learned to confine itself to single muscles, grows extreme, it overflows into larger muscular regions. He usually plays with his fingers, his body being at rest. But no sooner does he get excited than his whole body becomes 'animated,' and he moves his head and trunk, in particular, as if these also were organs with which he meant to belabor the keys." *

Man is born with a tendency to do more things than he has ready-made arrangements for in his nerve-centers. Most of the performances of other animals are automatic. In him, most of them must be the fruit of painful study. If practice did not make perfect, nor habit economize the expense of nervous and muscular energy, he would therefore be in a sorry plight. As Dr. Maudsley says,† "If an act became no easier after being done several times, if the careful direction of consciousness were necessary to its accomplishment on each occasion, it is evident that the whole activity of a lifetime might be confined to one or two deeds—that no progress could take place in development. A man might be occupied all day in dressing and undressing himself; the attitude of his body would absorb all his attention and energy; the washing of his hands or the fastening of a button

* G. H. Schneider, "Der menschliche Wille," 1882, pp. 417–419 (freely translated). For the drain-simile, cf. Spencer's "Psychology," Part V, chap. viii.

† "Physiology of Mind," p. 155.

would be as difficult to him on each occasion as to the child on its first trial; and he would, furthermore, be completely exhausted by his exertions. Think of the pains necessary to teach a child to stand, of the many efforts which it must make, and of the ease with which it at last stands, unconscious of any effort. For while secondarily automatic acts are accomplished with comparatively little weariness—in this regard approaching the organic movements, or the original reflex movements—the conscious effort of the will soon produces exhaustion. A spinal cord without . . . memory would simply be an idiotic spinal cord. . . . It is impossible for an individual to realize how much he owes to its automatic agency until disease has impaired its functions."

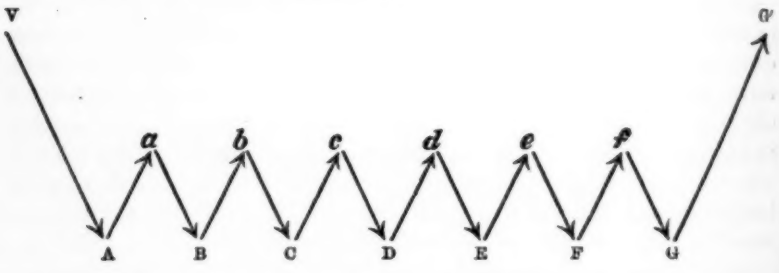
The next result is that *habit diminishes the conscious attention with which our actions are performed.*

One may state this abstractly thus: If an action require for its execution a chain, A, B, C, D, E, F, G, of successive nervous events; then in the first performances of the action, the conscious will must choose each of these events from a number of wrong alternatives that present themselves as possible; but habit soon brings it about that each event calls up its own appropriate successor without any alternative offering itself, and without any reference to the conscious will, until at last the whole chain, A, B, C, D, E, F, G, rattles itself off as soon as A occurs, just as if A and the rest of the chain were fused into a continuous stream. When we are learning to walk, to ride, to swim, skate, fence, write, play, or sing, we interrupt ourselves at every step by unnecessary movements and false notes. When we are proficients, on the contrary, the results not only follow with the very minimum of muscular action requisite to bring them forth, they also follow from a single instantaneous "cue." The marksman sees the bird, and, before he knows it, he has aimed and shot. A gleam in his adversary's eye, a momentary pressure from his rapier, and the fencer finds that he has instantly made the right parry and return. A glance at the musical hieroglyphics, and the pianist's fingers have rippled through a labyrinth of notes. And not only is it the right thing at the right time that we thus involuntarily do, but the wrong thing also, if it be an habitual thing. Who is there that has never wound up his watch on taking off his waistcoat in the daytime, or taken his latch-key out on arriving at the door-step of a friend? Very absent-minded persons in going to their bedroom to dress for dinner have been known to take off one garment after another and finally to get into bed, merely because that was the habitual issue of the first few movements when performed at a later hour. The writer well remembers how, on revisiting Paris after ten years' absence, and, finding himself in the street in which for one winter he had attended school, he lost himself in a brown study, from which he was awakened by finding himself upon the stairs which led to the apartment in a house many streets away in

which he had lived during that earlier time, and to which his steps from the school had then habitually led. We all of us have a definite routine manner of performing certain daily offices connected with the toilet, with the opening and shutting of familiar cupboards, and the like. Our lower centers know the order of these movements, and show their knowledge by their "surprise" if the objects are altered so as to oblige the movement to be made in a different way. But our higher thought-centers know hardly anything about the matter. Few men can tell off-hand which sock, shoe, or trousers-leg they put on first. They must first mentally rehearse the action; and even that is often insufficient—the action must be *performed.* So of the questions, Which valve of my double door opens first? Which way does my door swing? etc. I can not *tell* the answer; yet my *hand* never makes a mistake. No one can *describe* the order in which he brushes his hair or teeth; yet it is likely that the order is a pretty fixed one in all of us.

These results may be expressed as follows:

In actions become habitual, what instigates each new muscular contraction to take place in its appointed order is not a thought or a perception, but the *sensation occasioned by the muscular contraction just finished.* A strictly voluntary action has to be guided by idea, perception, and volition, throughout its course. In a secondarily automatic or habitual action, mere sensation is a sufficient guide, and the upper regions of brain and mind are set comparatively free. A diagram will make the matter clear:



Let A, B, C, D, E, F, G represent an habitual chain of muscular contractions, and let *a, b, c, d, e, f, g* stand for the respective sensations which these contractions excite in us when they are successively performed. Such sensations will usually be in the muscles, skin, or joints of the parts moved, but they may also be effects of the movement upon the eye or ear. Through them, and through them alone, we are made aware whether the contraction has or has not occurred. When the series, A, B, C, D, E, F, G, is being learned, each of these sensations becomes the object of a separate perception by the mind. By it we test each movement, to see if it be right before advancing to the next. We hesitate, compare, choose, revoke, reject, etc., by intellectual means; and the order by which the next movement is dis-

charged is an express order from the ideational centers after this deliberation has been gone through.

In habitual action, on the contrary, the only impulse which the centers of idea or perception need send down, is the initial impulse, the command to *start*. This is represented in the diagram by V; it may be a thought of the first movement or of the last result, or a mere perception of some of the habitual conditions of the chain, the presence, e. g., of the key-board near the hand. In the present case, no sooner has the conscious thought or volition instigated movement A, than A, through the sensation *a*, of its own occurrence awakens B reflexly; B then excites C through *b*, and so on till the chain is ended, when the intellect generally takes cognizance of the final result. The process, in fact, resembles the passage of a wave of "peristaltic" motion down the bowels. The intellectual perception at the end is indicated in the diagram by the effect of G being represented, at G′, in the ideational centers above the merely sensational line. The sensational impressions, *a*, *b*, *c*, *d*, *e*, *f*, are all supposed to have their seat below the ideational lines. That our ideational centers, if involved at all by *a*, *b*, *c*, *d*, *e*, *f*, are involved in a minimal degree, is shown by the fact that the attention may be wholly absorbed elsewhere. We may say our prayers, or repeat the alphabet, with our attention far away.

"A musical performer will play a piece which has become familiar by repetition, while carrying on an animated conversation, or while continuously engrossed by some train of deeply interesting thought; the accustomed sequence of movements being directly prompted by the *sight* of the notes, or by the remembered succession of the *sounds* (if the piece is played from memory), aided in both cases by the guiding sensations derived from the muscles themselves. But, further, a higher degree of the same 'training' (acting on an organism specially fitted to profit by it) enables an accomplished pianist to play a difficult piece of music at sight; the movements of the hands and fingers following so immediately upon the sight of the notes, that it seems impossible to believe that any but the very shortest and most direct track can be the channel of the nervous communication through which they are called forth. The following curious example of the same class of *acquired aptitudes*, which differ from instincts only in being prompted to action by the will, is furnished by Robert Houdin:

"With a view of cultivating the rapidity of visual and tactile perception, and the precision of respondent movements, which are necessary for success in every kind of prestidigitation, Houdin early practiced the art of juggling with balls in the air; and having, after a month's practice, become thorough master of the art of keeping up *four* balls at once, he placed a book before him, and, while the balls were in the air, accustomed himself to read without hesitation. 'This,' he says, 'will probably seem to my readers very extraordinary; but I shall surprise them still more when I say that I have just amused my-

self with repeating this curious experiment. Though thirty years have elapsed since the time I was writing, and though I have scarcely once touched my balls during that period, I can still manage to read with ease while keeping *three* balls up'" (Autobiography, p. 26).*

We have called *a*, *b*, *c*, *d*, *e*, *f*, the antecedents of the successive muscular attractions, by the name of sensations. Some authors seem inclined to deny that they are even this. If not even this, they can only be centripetal nerve-currents, not sufficient to arouse feeling, but sufficient to arouse motor response.† It may be at once admitted that they are not distinct *volitions*. The will, if any will be present, limits itself to a *permission* that they exert their motor effects. Dr. Carpenter writes: "There may still be metaphysicians who maintain that actions which were originally prompted by the will with a distinct intention, and which are still entirely under its control, can never cease to be volitional; and that either an infinitesimally small amount of will is required to sustain them when they have been once set going, or that the will is in a sort of pendulum-like oscillation between the two actions—the maintenance of the train of *thought*, and the maintenance of the train of *movement*. But if only an infinitesimally small amount of will is necessary to sustain them, is not this tantamount to saying that they go on by a force of their own? And does not the experience of the *perfect continuity* of our trains of thought during the performance of movements that have become habitual, entirely negative the hypothesis of oscillation? Besides, if such an oscillation existed, there must be *intervals* in which each action goes on *of itself;* so that its essentially automatic character is virtually admitted. The physiological explanation, that the mechanism of locomotion, as of other habitual movements, *grows to* the mode in which it is early exercised, and that it then works automatically under the general control and direction of the will, can scarcely be put down by any assumption of an hypothetical necessity, which rests only on the basis of ignorance of one side of our composite nature."‡

But if not distinct acts of will, these immediate antecedents of each movement of the chain are at any rate accompanied by consciousness of some kind. They are *sensations* to which we are *usually inattentive*, but which immediately call our attention if they go *wrong*. Schneider's account of these sensations deserves to be quoted. In the act of walking, he says, even when our attention is entirely off, "we are continuously aware of certain muscular feelings; and we have, moreover, a feeling of certain impulses to keep our equilibrium and to set down one leg after another. It is doubtful whether we could preserve equilibrium if no sensation of our body's attitude were there, and doubtful

* Carpenter's "Mental Physiology," 1874, pp. 217, 218.

† Von Hartmann devotes a chapter of his "Philosophy of the Unconscious" (English translation, vol. i, p. 72) to proving that they must be both *ideas* and *unconscious*.

‡ "Mental Physiology," p. 20.

whether we should advance our leg if we had no sensation of its movement as executed, and not even a minimal feeling of impulse to set it down. Knitting appears altogether mechanical, and the knitter keeps up her knitting even while she reads or is engaged in lively talk. But if we ask her how this be possible, she will hardly reply that the knitting goes on of itself. She will rather say that she has a feeling of it, that she feels in her hands that she knits and how she must knit, and that therefore the movements of knitting are called forth and regulated by the sensations associated therewithal, even when the attention is called away.

"So of every one who practices, apparently automatically, a long familiar handicraft. The smith turning his tongs, as he smites the iron, the carpenter wielding his plane, the lace-maker with her bobbin, the weaver at his loom, all will answer the same question in the same way by saying that they have a feeling of the proper management of the implement in their hands.

"In these cases, the feelings which are conditions of the appropriate acts, are very faint. But none the less are they necessary. Imagine your hands not feeling; your movements could then only be provoked by ideas, and if your ideas were then diverted away, the movements ought to come to a standstill, which is a consequence that seldom occurs."* Again—

"An idea makes you take, for example, a violin into your left hand. But it is not necessary that your idea should remain fixed on the contraction of the muscles of the left hand and fingers, in order that the violin should continue to be held fast and not let fall. The sensations themselves which the holding of the instrument awakens in the hand, since they are associated with the motor impulse of grasping, are sufficient to cause this impulse, which then lasts as long as the feeling itself lasts, or until the impulse is inhibited by the idea of some antagonistic motion." And the same may be said of the manner in which the right hand holds the bow. "It sometimes happens, in beginning these simultaneous combinations, that one movement or impulse will cease, if the consciousness turns particularly toward another, because at the outset the guiding sensations must *all* be strongly *felt*. The bow will perhaps slip from the fingers, because some of the muscles have relaxed. But the slipping is a cause of new sensations starting up in the hand, so that the attention is in a moment brought back to the grasping of the bow.

"The following experiment shows this well: When one begins to play on the violin, to keep him from raising his right elbow in playing a book is placed under his right armpit, which he is ordered to hold fast by keeping the upper arm tight against his body. The muscular feelings, and feelings of contact connected with the book, provoke an impulse to press it tight. But often it happens that the beginner,

* "Der menschliche Wille," pp. 447, 448.

whose attention gets absorbed in the production of the notes, lets drop the book. Later, however, this never happens; the faintest sensations of contact suffice to awaken the impulse to keep it in its place, and the attention may be wholly absorbed by the notes and the fingering with the left hand. *The simultaneous combination of movements is thus in the first instance conditioned by the facility with which, in us alongside of intellectual processes, processes of inattentive feeling may still go on.*" *

This brings us by a very natural transition to the ethical implications of the law of habit. They are numerous and momentous. Dr. Carpenter, from whose "Mental Physiology" we have quoted, has so prominently enforced the principle that our organs grow to the way in which they have been exercised, and dwelt upon its consequences, that his book almost deserves to be called a work of edification, on this account alone. We need make no apology, then, for tracing a few of these consequences ourselves:

"Habit a second nature! Habit is ten times nature," the Duke of Wellington is said to have exclaimed; and the degree to which this is true no one can probably appreciate as well as one who is a veteran soldier himself. The daily drill and the years of discipline end by fashioning a man completely over again, as to most of the possibilities of his conduct. "There is a story, which is credible enough, though it may not be true, of a practical joker, who, seeing a discharged veteran carrying home his dinner, suddenly called out, 'Attention!' whereupon the man instantly brought his hands down, and lost his mutton and potatoes in the gutter. The drill had been thorough, and its effects had become embodied in the man's nervous structure." †

Riderless cavalry-horses, at many a battle, have been seen to come together and go through their customary evolutions at the sound of the bugle-call. Most trained domestic animals, dogs, and oxen, and omnibus- and car-horses, seem to be machines almost pure and simple, undoubtingly, unhesitatingly doing from minute to minute the duties they have been taught, and giving no sign that the possibility of an alternative ever suggests itself to their mind. Men grown old in prison have asked to be readmitted after being once set free. In a railroad accident to a traveling menagerie in the United States some time in 1884, a tiger, whose cage had broken open, is said to have emerged, but presently crept back again, as if too much bewildered by his new responsibilities, so that he was without difficulty secured.

Habit is thus the enormous fly-wheel of society, its most precious conservative agent. It alone is what keeps us all within the bounds of ordinance, and saves the children of fortune from the envious uprisings of the poor. It alone prevents the hardest and most repulsive

* "Der menschliche Wille," p. 439. The last sentence is rather freely translated—the sense is unaltered.

† Huxley's "Elementary Lessons in Physiology," lesson xii.

walks of life from being deserted by those brought up to tread therein. It keeps the fisherman and the deck-hand at sea through the winter; it holds the miner in his darkness, and nails the countryman to his log-cabin and his lonely farm through all the months of snow; it protects us from invasion by the natives of the desert and the frozen zone. It dooms us all to fight out the battle of life upon the lines of our nurture or our early choice, and to make the best of a pursuit that disagrees, because there is no other for which we are fitted, and it is too late to begin again. It keeps different social strata from mixing. Already at the age of twenty-five you see the professional mannerism settling down on the young commercial traveler, on the young doctor, on the young minister, on the young counselor-at-law. You see the little lines of cleavage running through the character, the tricks of thought, the prejudices, the ways of the "shop" in a word, from which the man can by-and-by no more escape than his coat-sleeve can suddenly fall into a new set of folds. On the whole, it is best he should not escape. It is well for the world that in most of us, by the age of thirty, the character has set like plaster, and will never soften again.

If the period between twenty and thirty is the critical one in the formation of intellectual and professional habits, the period below twenty is more important still for the fixing of *personal* habits, properly so called, such as vocalization and pronunciation, gesture, motion, and address. Hardly ever is a language learned after twenty spoken without a foreign accent; hardly ever can a youth transferred to the society of his betters unlearn the nasality and other vices of speech bred in him by the associations of his growing years. Hardly ever, indeed, no matter how much money there be in his pocket, can he even learn to *dress* like a gentleman-born. The merchants offer their wares as eagerly to him as to the veriest "swell," but he simply *can't* buy the right things. An invisible law, as strong as gravitation, keeps him within his orbit, arrayed this year as he was the last; and how his aristocratic acquaintances contrive to get the things they wear, will be for him a mystery till his dying day.

The great thing, then, in all education, is to *make automatic and habitual, as early as possible, as many useful actions as we can,* and to guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague. The more of the details of our daily life we can hand over to the infallible and effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work. There is no more miserable human being than one in whom nothing is habitual but indecision, and for whom the lighting of every cigar, the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work, are subjects of express volitional deliberation. Full half the time of such a man goes to the deciding, or regretting,

of matters which ought to have been so thoroughly ingrained in him as practically not to exist for his consciousness at all. If there be such daily duties not yet ingrained in any one of my readers, let him begin this very day to set the matter right.

In Professor Bain's chapter on "The Moral Habits" there are some admirable practical remarks laid down. Two great maxims emerge from his treatment. The first is that in the acquisition of a new habit, or the leaving off of an old one, we must take care to *launch ourselves with as strong and decided an initiative as possible.* Accumulate all the possible circumstances which shall re-enforce the right motives; put yourself assiduously in conditions that encourage the new way; make engagements incompatible with the old; take a public pledge, if the case allows; in short, envelop your resolution with every aid you know. This will give your new beginning such a momentum that the temptation to break down will not occur as soon as it otherwise might; and every day during which a breakdown is postponed adds to the chances of its not occurring at all.

The second maxim is: *Never suffer an exception to occur till the new habit is securely rooted in your life.* Each lapse is like the letting fall of a ball of string which one is carefully winding up; a single slip undoes more than a great many turns will wind again. *Continuity* of training is the great means of making the nervous system act infallibly right. As Professor Bain says: "The peculiarity of the moral habits, contradistinguishing them from the intellectual acquisitions, is the presence of two hostile powers, one to be gradually raised into the ascendant over the other. It is necessary, above all things, in such a situation, never to lose a battle. Every gain on the wrong side undoes the effect of many conquests on the right. The essential precaution, therefore, is so to regulate the two opposing powers, that the one may have a series of uninterrupted successes, until repetition has fortified it to such a degree as to enable it to cope with the opposition, under any circumstances. This is the theoretically best career of mental progress."

The question of "tapering-off," in abandoning such habits as drink and opium-indulgence, comes in here, and is a question about which experts differ within certain limits, and in regard to what may be best for an individual case. In the main, however, all expert opinion would agree that abrupt acquisition of the new habit is the best way, *if there be a real possibility of carrying it out.* We must be careful not to give the will so stiff a task as to insure its defeat at the very outset; but, *provided one can stand it,* a sharp period of suffering, and then a free time, is the best thing to aim at, whether in giving up a habit like that of opium, or in simply changing one's hours of rising or of work. It is surprising how soon a desire will die of inanition if it be *never* fed. "One must first learn, unmoved, looking neither to the right nor left, to walk firmly on the straight and narrow

path, before one can begin 'to make one's self over again.' He who every day makes a fresh resolve is like one who, arriving at the edge of the ditch he is to leap, forever stops and returns for a fresh run. Without *unbroken* advance, there is no such thing as *accumulation* of the ethical forces possible, and to make this possible, and to exercise us and habituate us in it is the sovereign blessing of regular *work*."*

A third maxim may be added to the preceding pair: *Seize the very first possible opportunity to act on every resolution you make, and on every emotional prompting you may experience in the direction of the habits you aspire to gain.* It is not in the moment of their forming, but in the moment of their producing *motor effects*, that resolves and aspirations communicate the new "set" to the brain. As the author last quoted remarks: "The actual presence of the practical opportunity alone furnishes the fulcrum upon which the lever can rest, by means of which the moral will may multiply its strength, and raise itself aloft. He who has no solid ground to press against, will never get beyond the stage of empty gesture-making." No matter how full a reservoir of *maxims* one may possess, and no matter how good one's *sentiments* may be, if one have not taken advantage of every concrete opportunity to *act*, one's character may remain entirely unaffected for the better. With mere good intentions, hell is proverbially paved. And this is an obvious consequence of the principles we have laid down. A "character," as J. S. Mill, says, "is a completely fashioned will"; and a will, in the sense in which he means it, is an aggregate of tendencies to act in a firm and prompt and definite way upon all the principal emergencies of life. A tendency to act only becomes effectively ingrained in us in proportion to the uninterrupted frequency with which the actions actually occur, and the brain "grows" to their use. Every time a resolve or a fine glow of feeling evaporates without bearing practical fruit, is worse than a chance lost; it works so as positively to hinder future resolutions and emotions from taking the normal path of discharge. There is no more contemptible type of human character than that of the nerveless sentimentalist and dreamer, who spends his life in a weltering sea of sensibility and emotion, but who never does a manly concrete deed. Rousseau, inflaming all the mothers of France, by his eloquence, to follow Nature and nurse their babies themselves, while he sends his own children to the foundling hospital, is the classical example of what I mean. But every one of us in his measure, whenever, after glowing for an abstractly formulated Good, he practically ignores some actual case, among the squalid "other particulars" of which that same Good lurks disguised, treads straight on Rousseau's path. All Goods are disguised by the vulgarity of their concomitants, in this world; but woe to work-a-day him who can only recognize them when he thinks them in their pure and abstract form! The habit of

* J. Bahnsen, "Beiträge zu Charakterologie," 1867, vol. i, p. 209.

excessive novel-reading and theatre-going will produce true monsters in this line. The weeping of the Russian lady over the fictitious personages in the play, while her coachman is freezing to death on his seat outside, is the sort of thing that everywhere happens on a less glaring scale. Even the habit of excessive indulgence in music, for those who are neither performers themselves nor musically gifted enough to take it in a purely intellectual way, has probably a relaxing effect upon the character. One becomes filled with emotions which habitually pass without prompting to any deed, and so the inertly sentimental condition is kept up. The remedy would be, never to suffer one's self to have an emotion at a concert, without expressing it afterward in *some* active way. Let the expression be the least thing in the world—the giving up of one's seat in a horse-car, if nothing more heroic offers—but let it not fail to take place.

These latter cases make us aware that it is not simply *particular lines* of discharge, but also *general forms* of discharge, that seem to be grooved out by habit in the brain. Just as, if we let our emotions evaporate, they get into a way of evaporating; so there is reason to suppose that if we often flinch from making an effort, before we know it the effort-making capacity will be gone; and that, if we suffer the wandering of our attention, presently it will wander all the time. Attention and effort are, as we shall see later, but two names for the same psychic fact. To what brain-processes they correspond, we do not know. The strongest reason for believing that they do depend on brain-processes at all, and are not pure acts of the spirit, is just this fact, that they seem in some degree subject to the law of habit, which is a material law. As a final practical maxim, relative to these habits of the will, we may, then, offer something like this: *Keep the faculty of effort alive in you by a little gratuitous exercise every day.* That is, be systematically ascetic or heroic in little unnecessary points, do every day or two something for no other reason than that you would rather not do it, so that when the hour of dire need draws nigh, it may find you not unarmed and untrained to stand the test. Asceticism of this sort is like the insurance a man pays on his house and goods. The tax does him no good at the time, and possibly may never bring him in a return. But if the fire *does* come, his having paid it will be his salvation from ruin. So with the man who has daily inured himself to habits of concentrated attention, energetic volition, and self-denial in unnecessary things. He will stand like a tower when everything rocks around him, and when his softer fellow-mortals are winnowed like chaff in the blast.

The physiological study of mental conditions is thus the most powerful ally of hortatory ethics. The hell to be endured hereafter, of which theology tells, is no worse than the hell we make for ourselves in this world by habitually fashioning our characters in the wrong way. Could the young but realize how soon they will become mere walking

bundles of habits, they would give more heed to their conduct while in the plastic state. We are spinning our own fates, good or evil, and never to be undone. Every smallest stroke of virtue or of vice leaves its never so little scar. The drunken Rip Van Winkle, in Jefferson's play, excuses himself for every fresh dereliction by saying, "I won't count this time!" Well! he may not count it, and a kind Heaven may not count it; but it is being counted none the less. Down among his nerve-cells and fibers the molecules are counting it, registering and storing it up to be used against him when the next temptaton comes. Nothing we ever do is, in strict scientific literalness, wiped out. Of course, this has its good side as well as its bad one. As we become permanent drunkards by so many separate drinks, so we become saints in the moral, and authorities and experts in the practical and scientific spheres, by so many separate acts and hours of work. Let no youth have any anxiety about the upshot of his education, whatever the line of it may be. If he keep faithfully busy each hour of the working-day, he may safely leave the final result to itself. He can with perfect certainty count on waking up some fine morning, to find himself one of the competent ones of his generation, in whatever pursuit he may have singled out. Silently, between all the details of his business, the *power of judging* in all that class of matter will have built itself up within him as a possession that will never pass away. Young people should know this truth in advance. The ignorance of it has probably engendered more discouragement and faint-heartedness in youths embarking on arduous careers than all other causes put together.

SCIENCE IN RELIGIOUS EDUCATION.

By DANIEL GREENLEAF THOMPSON.

II.

[*Concluded.*]

LET us now turn our attention to those higher seminaries of learning, which, though often assisted by public funds, or patronized in one way or another by the state, are not exclusively state institutions. Wherever a college or university happens to be under state control, precisely the same principles should obtain regarding the teaching of religion as we have found applicable in the case of inferior schools. Indeed, whether the institution be public or private, these principles equally apply, but there are some differences in situation of which we must take note.

Undoubtedly a religious organization has and should have the right to found and maintain schools to educate the young into its beliefs. Most of the New England colleges were established primarily to train

young men for the Christian ministry, and in nearly all of them the promotion of the Christian religion (by which is meant the so-called evangelical religion) is the first object. As subsidiary to this come science, languages, and *belles-lettres* generally. Upon this basis, indeed, the greater part of the collegiate institutions in England and America stand to-day. With respect to all such, then, the question is, whether they are to be approved and supported; and, if not, what should be done to change their character so as to counteract whatever is unfortunate or baneful in their influences.

An ideal of education which sets up the attainment of truth before everything else, and claims not only the right but the necessity of questioning all things and proving all things, never can be satisfied with the constitution of any college or university whose first end and purpose is to promote any religion whatever, be it Christian, Mohammedan, Confucian, or Buddhistic. A theological seminary to be entered after general education, may properly be sectarian and be maintained for the special purpose of teaching any kind of dogma that its founders and patrons desire taught. Not so, however, with an institution for general academic instruction and study. And it must not be overlooked that an institution whose chief aim is "to promote the religion of Christ," though apparently this would include many sects, is, after all, necessarily sectarian and partisan. To begin with, it is sectarian, because, since there are many Christian sects and a great variety of Christian doctrines, some form of this doctrine must be selected and favored, if "promotion" be the chief object. Any organization for convincing and persuading must have something respecting which it is to convince and persuade. It thus can not avoid being sectarian, if it preserves any character as an effective promoting force. Such we find actually to be the case. Either by agreement at the outset or by a process of natural selection, colleges and seminaries whose chief aim is to promote the religion of Christ become inevitably Roman Catholic, Episcopalian, Baptist, Methodist, Presbyterian, Congregationalist, or something else, according to circumstances. However liberal they may be in selecting teachers for other departments, the religious teaching is all of a kind, just in the measure that they make the advancement of religion an object. Thus, though college authorities declare in their prospectus, for the purpose of attracting students, that their teaching is not sectarian, a person who reflects on the subject will not be deceived. It must be sectarian, so far as it is aggressively religious, although it may be very tolerant of all sects whose tenets are like its own. If the dominant sect differs from another only on the question of the mode of baptism, no very great amount of disfavor toward the latter would be discovered. But let the point of difference be the divinity of Christ, or the question of eternal punishment, and we shall soon see developed the strength of sectarian feeling in a manner sufficient to remove all doubts.

Even if there were unity of belief in Christianity, the existence of other religions in the world, supported by millions of people, is of itself sufficient to make the man who loves truth above all things demand for higher educational institutions something more truly catholic for an aim than the promotion of any one religion. If the highest truth be coincident with Christian doctrine; then, if truth in itself be made the chief end, the only result is to advance Christianity also, while there is no possible ground of reproach on the score of sectarianism. Such a reproach is not alone liable to come from atheists and agnostics, who may be considered possibly to have no rights which Christians are bound to respect. There happens to be in Christian communities a large class of people of the highest degree of enlightenment to whom the central doctrines of Christianity are repugnant, and who are devoted to a religion of their own—the religion, indeed, out of which Christianity sprang, but a religion which does not recognize any divine character in Jesus of Nazareth or any divine mission in his career. Such people are not atheists or agnostics. They worship the same God as the Christians do; and they adopt as a sacred book more than half the Christian Bible. In former times Christians used to treat them with the greatest contumely, scarcely as human beings, in fact; in some parts of the world to-day they are persecuted. But in countries where equality before the law is the rule, they have the same rights as other people; and their religious views ought to be recognized in those institutions to which they contribute. The existence of a large number of believers in the Jewish religion is certainly an additional argument against dogmatic religious teaching in any seminary of learning which seeks or obtains state aid. It is also conclusive against the claim that to promote Christianity is not a sectarian aim, for by the expression not alone practical or humanitarian, but doctrinal or theological Christianity is always intended.

Yet this contention that they are in no wise sectarian or partisan continues to he made by distinctively Christian colleges. Under this declaration, they open their doors to the world and profess to give the youth all the higher instruction he needs. They claim to teach knowledge, science, truth. But they certainly would not allow anything to be truth which militates against Christianity as an exclusive religion, as the only hope for mankind—this hope lying not in the spirit of altruism pervading Christianity but in loyalty to Jesus Christ personally as the sole Redeemer and Saviour. The Jewish view of Jesus would not be tolerated for an instant; the Unitarian belief is not less obnoxious; the agnostic humility is thought blasphemous. The possibility of the "orthodox" principles and facts being error is not to be allowed or considered! The chief business of these institutions is to maintain the truth of their religious creed as a postulate not to be questioned, as an assumed point of departure for all acquisition of knowledge, and as the supreme end of all learning. For instance, President Adams, of

Cornell University (1886), declares that the university "must always be on the side of Christianity as opposed to infidelity or unbelief." President Seelye, of Amherst College, declares in his inaugural (1877) that the college must be solicitous, "first of all, to continue Christian." "It will seek for Christian teachers and only these." On these principles, "it will order all its studies and its discipline." It is, then, idle to say that such institutions will teach science or truth, except as science and truth are in accord with "evangelical" Christian theology. Everything else is necessarily untruth, unreason, error. Said President Witherspoon, of Princeton: "Cursed be all that learning that is contrary to the cross of Christ; cursed be all that learning that is not coincident with the cross of Christ; cursed be all that learning that is not subservient to the cross of Christ!"

While there must be liberty to establish denominational and sectarian colleges to "promote" religion; and if, while there are such, it is the best public policy to have as great a variety of beliefs represented as may be possible, in order to insure healthful counteraction, this condition of things does not fulfill the demands of a scientific educational system. When we send our young men and women to learn geometry or natural philosophy, it is geometry and natural philosophy as sciences, as matters of knowledge, truth, that we wish them taught; not Presbyterian or Episcopalian or Methodist geometry or physics. There are church schools where church creeds are inculcated, and in these the youth can learn the things that belong to their particular sect. Or, if it be desirable to have such teaching in the same school which teaches geometry, there is no serious objection to a professorship of the soundest kind of the special orthodoxy desired, so long as the opposite kind of orthodoxy is not denied similar privileges. By keeping the professorship of geometry or biology unfettered by any complications with the professorship of Presbyterian theology, both biology and Presbyterianism might be learned in the same college. Then the qualification for a teacher of biology would be that he knows biology, and his religious belief would be irrelevant. As it is, whenever we examine college catalogues we discover the title "Reverend" prefixed to the names of most of the professors, even of languages and science. This creates a suspicion which is confirmed absolutely when we find, as we do in many colleges, that no one who is not a professing Christian is eligible to the position of teacher! Charles Darwin would not have been "fit" to teach biology; nor would Huxley be fit to teach natural history, nor Tyndall to give instruction in physics! Institutions like these may be provisionally endurable; but they do not satisfy the highest ideals either of truth or morality. Unless the policy of the fagot should return and become successful once more, they must be superseded by something better.

The effort ought to be made, therefore, to establish and maintain a larger number of colleges and universities which shall be absolutely

without any religious *purpose* or aim, but which shall furnish facilities to the student for obtaining instruction in the comparative study of religions, and in the tenets of the leading religious sects, such instruction to be critical, not authoritative. These universities should be broad enough to cover all branches of science, including religions, and each department should stand upon its own foundation. The teacher of Latin should be qualified by reason of his knowledge of Latin and ability to communicate it, and it should matter not whether he be a Christian. The government of the institution should be wholly impartial as regards religion, and its charter ought to forbid religious discrimination in any form. As to worship, the teaching of religion by insinuation, that should have no place in a university save as a matter of voluntary attention. Of a college church there can be no need; for in any college-town there are, no doubt, ample opportunities for the enjoyment of religious services among the churches of the neighborhood.

Such a scheme of collegiate institutions has commended itself to a great many thinking people, but the importance of creating and sustaining the like should be more sensibly appreciated. The Christian church has always been alive to the value of education for the promotion of its own interests. The monks were usually men of peace, but, through their care for the instruction of youth, they became more powerful than the men of war. Though they were working chiefly to perpetuate the power of their order, the world is greatly indebted to them for the preservation of learning and the interest in its acquisition. It is true enough that the church has been in times past the foster-mother of education, but it is not true, therefore, that education will not flourish except under the auspices of religious organization. Let it be impressed upon the community that for the preservation of the social organism education is necessary, for the life that now is; for good government and a larger liberty, and just as powerful a motive is created to promote it as any that loyalty to an ecclesiastical society can originate. To encourage this thought, and to secure its practical carrying out, should be the aim of those who believe in a stable social order; who appreciate, indeed, the value of knowledge in religious matters so well that they are not willing to rest content with partial truth and error. Some institutions of learning there are that foster such a sentiment, and which in their constitution are substantially free from religious partisanship; it is desirable to have more.

Modifying influences are everywhere at work upon existing colleges and universities, and they are nearly all in some degree susceptible of improvement in the directions I have indicated. They desire students and must have funds. The best method of making them understand their short-comings is to cut off their supplies of both. But the higher education must be had, and if it can not be obtained in a non-sectarian institution, the conditions are often such that with

proper antidotes the sectarianism inculcated may not do much harm. It is a significant fact that in some of the American colleges, founded to train young men for the Christian ministry, a very small and continually decreasing number of graduates embrace that profession. Emotional revivals are growing less in favor and are of less influence. The strong tendency of public sentiment, at least among the patrons of colleges, is toward the abolition of compulsory worship, and this has been effected in the largest American university. Thus, it may be said that there has been in America a progressive secularisation of colleges, spite of the resistance offered by their boards of government. The university systems of Continental Europe already allow much greater freedom from coercive influences of religious creeds. The American college system must give way to the broader plan exemplified in Germany, and to some extent in England, and proceed still further in the direction of making religious instruction only a department on equal footing with other departments. Those who are interested in existing collegiate schools, and who esteem it to be a higher, nobler, more truly religious ideal of education, that truth, verified knowledge, be sought persistently, and be inculcated regardless of its consequences upon a religious system maintained by authority, should not rest until the narrower object of promoting any religion ceases to be the chief end and aim toward which all the teaching in the institution converges.

This result can scarcely be brought about so long as the government and instruction in such institutions is confided in a controlling degree to clergymen. Now in this class there are, of course, many learned, catholic, truth-loving men ; but the trouble is, they are all under retainers and have necessarily a professional duty which they must first perform. Doubtless they have in each case espoused a cause in which they fully believe ; but their opinion, upon any point which touches the interests of their churches or their church, is of no more value as regards truth than the statements before the court of counsel in a law case. It is to be hoped that falsehood will not be practiced or countenanced either by the clerical or the legal advocate ; in both instances what is said is probably believed to be true ; but the mind of each is necessarily shut to anything that militates against the party for whom he appears, except for the purpose of refutation. It would not be just to allow one of the attorneys in an action at law to decide the case. This is what we are doing, however, when we put clergymen in control of educational institutions. As judges of truth, they are not "fit" to pass upon any question which concerns the welfare of their respective religious systems. They are disqualified by reason of interest. But such judges we need in our schools and colleges. If it were not for religious bias and intolerance we might have them ; if the scientific method of instruction in religion were adopted, we certainly should have them. But until such a happy day arrives, so long as we

must have advocates without judges we shall get at truth much faster and with greater certainty if at least we hear both sides. Let clergymen be appointed to professorships relating to their calling. Then they are in their place. Let them also be represented in boards of government; but to give them any longer the controlling power either in faculty or among trustees, or in the presidential office, is to interpose the most effectual means to arrest progress in higher education, to defeat the healthy growth of intelligence, and to dwarf and shrivel the characters of the students, who ought to receive from such institutions a thoroughly enlarging and ennobling influence.

If this seems ungracious, as doubtless it will to some, it must be insisted, with courtesy, indeed, but with firmness, that a necessity exists for reducing the too extravagant claims of the clerical profession to authority by reason of their office. They consider that their position, as representatives of a higher power than man, makes their anger righteous, and renders opposition to their declarations impious. Hence they attack with great vigor and often vituperation, but, if the objects of their wrath turn in self-defense, the rain of anathemas is increased tenfold; and should it happen that they are worsted in the conflict, they begin to cry out that they are persecuted! Now, patience is a virtue, and ought to be exercised; it is the weak rather than the strong who are intolerant; but surely people who claim more than they are entitled to must not expect that their claims will be recognized. Much less, when their demands for respect involve the stoppage of progress in knowledge and inquiry, can they reasonably anticipate acquiescence. Clergymen often complain of the increasing lack of deference shown to their order by the laity, while they bitterly lament their very conspicuous loss of influence. Reflection, however, ought to make the causes plain to them. The simple truth is, that they have latterly been growing to be of less value to the community. Many, indeed, are most excellent and useful members of society, and such do not fail of receiving full recognition. But, on the other hand, many are obstructionists to the advancement of civilization. And it must be said, also, that far too many are substantially paupers. They are supported by the community's earnings, and give nothing in return. They do not even express thankfulness for what they receive. If offered a crust of bread, they cry out for the best the table affords, and threaten the good housewife if they do not get it. Until they become moral and intellectual producers, they have no right to consume. If, therefore, when they are rebuked, they think those who rebuke them to be arrogant, in justice they must be plainly reminded of their situation. Clergymen must neither ask immunity from criticism because they are clergymen, nor must they expect to dominate the educational sphere through any "inherent sacredness" of their profession. If they attack, they must not complain if they are attacked. If they think more highly of themselves than they ought to

think, they must not feel aggrieved if they sometimes find their pretensions ignored or treated with contempt. The gist of this whole matter is, that the doctrine of inherent authority in any statement, principle, profession, or office must be abandoned.

Where we find the position taken that anything or anybody must not be questioned or criticised, we may be sure that then ignorance, error, or oppression exists, as latent if not patent evil.

It will be a great pity if religious men and women misapprehend the meaning of modern scientific criticism of Christian doctrine and of religious organization. If they did but know it, the salvation of present organized religion depends upon this criticism. The most serious question which weighs upon the thought of earnest men who are lovers of their kind is, how to save the good which there is in Christianity and perpetuate it for the human race. The edifice is at present in danger of ruin, through the folly of its guardians. No one can deny the service which Christianity has rendered; but people will not see what it is in Christianity which has brought about the benefit. It is the altruistic element which, affecting character, has caused men to seek growth through assimilation, instead of pushing their way in the world by mechanical impact. It is the encouragement to natural development produced by Christianity, and by other causes as well, which has worked the change in humanity. It is the ideal of human perfection, and of organic connection in society as the only way to realize that ideal, which has given its glory to the Christian system. It is the general doctrine and the special dogmas of authority which have constantly interfered with and nullified its beneficent tendencies. It may be that, in days gone by, the supernatural machinery, the stringent ecclesiastical organization was necessary, to keep alive the Christian, humanitarian spirit; for, in past times, force and fear ruled, and nothing could be sustained without physical power behind it. The present situation, when an industrial civilization is superseding the militant, is altogether different. It is no longer possible for religious authority to sustain itself; its day has gone by. The clergy do not see this; they will not recognize environing conditions. They can not be made to understand that what was good is now passing to better, and that the soul of things is, after all, sweet. They sorrow and are angered; but their hell is really of their own making. Upon the world the blessed light of a new and a more perfect day is dawning. They must either flee away with the darkness, or they must let the light penetrate their souls. If they will allow the latter, they will behold a much more glorious vision of Beauty, Truth and Goodness, the three sisters "never to be sundered without tears." The good in Christianity will not die, though errors be found, acknowledged, and discarded. Religion will not pass away, because it is inbred in the human mental constitution. The men who are accused of seeking to destroy Christianity are its best friends. There is not a Christian

church which may not stand, increase its membership, and become a much more active power for good, if only it will abandon its superstitions. The clergy say that to do this is to abandon Christianity. A great many of the laity do not think so. That is the issue. In the absence of some effective counsel of reconciliation, more destructive work will have to be done. Meanwhile, I cordially invite the clergy to become scientists. If existing religious organizations are to be preserved, the scientific method must be unqualifiedly adopted and prosecuted in the study and teaching of religion. By this method, ecclesiasticism may be transformed, and organized religion saved. Without it, deterioration will go on till the ruin is complete. If the present system of organized Christianity perish, however, the men who are responsible for its destruction will be those officially in charge of its interests; who might have saved it if they would, but were not wise in time; who would not believe in the power of social forces; who refused to perceive the necessity of adaptation, the certainty and the beneficence of change; who had not faith in the God of their worship, as he works in and through Nature; and who would not allow their own minds to awake from their dead selves and rise "to nobler verities."

To conclude, now, these remarks upon religious education, let me sum up what I conceive to be the scientific position. Religious truth should be taught in schools and seminaries of learning as far as it is a matter of scientific knowledge, but critically and not with the purpose of promoting any religion. The utmost care should be taken to present arguments for and against any statement of fact, or any inference, judicially and without the arts of persuasion. Doubt and inquiry should be favored and stimulated, not discouraged or repressed. If this can be accomplished, it is desirable to have religion, as something to be studied in its relations to truth, to character and conduct, taught in public and other schools. But if this method can not be followed, then, until there is unanimity of opinion as to what is true in religion, all teaching on the subject must be excluded from the public schools. In other institutions effort should be made to introduce and develop the scientific, the critical, the comparative method in this sort of instruction, while every encouragement should be given also to the establishment of schools, colleges, and universities, where its adoption and consistent practice shall be insured.

THE SOUTH-AFRICAN DIAMOND-MINES.

IT was a pleasant fancy of a writer in the "Cornhill Magazine," to argue for the plausibility of the fairy-story of the princess from whose pretty lips "fell diamonds, both in speaking and in singing, and even in silence," when she merely smiled. "For, consider," he says,

"into what does the diamond blaze, when, on combustion, the spirit of the gem leaps upward home again to its parent, the sun; into what but carbonic-acid gas?—that *carbon dioxide* of the chemist which attends the combustion of every fire- and gas-burner, the decomposition of every vegetable, which is exhaled in every breath we breathe?" The same writer also utters the less pleasing but equally striking thought that "the chimney-sweep is covered by that which, under happier auspices, would be jewels."

The diamond is mentioned very anciently in literature. Jupiter, according to classical mythology, was anxious to make men forget the days he had spent among them, and finding that one man—Diamond of Crete—remembered him, turned him into a stone: not a very credible story of the origin of the gem, but men of science in the nineteenth century are not much nearer to knowing the truth on the subject. The Greeks call the stone *adamas* (ἀδάμας) the indomptable or unchangeable; and from this has come down our word *adamantine* and, after the letters have undergone changes of a kind that are not rare in the growth of language, our name of the stone itself. But, long before the Greeks had emerged from the darkness of the mythic age, the diamond was made, among the Hebrews, the peculiar jewel of the tribe of Zebulon; and Aaron's breastplate, when he was dressed in his priestly robes, was adorned in the second of the four rows of its setting with precious stones—with an emerald, a sapphire, and a diamond; and Jeremiah, when the Greeks were just beginning to be known, rebuking the misgoings of his people, said, "The sin of Judah is written with a pen of iron, and with the point of a diamond."

But, although the ancients considered the diamond indestructible, and were capable of trying the most daring experiments with it, no specimen that is known to have belonged to them has come down to us. Some persons suppose that the Koh-i-nor is five thousand years old, as man's possession, but no one knows or can trace its history back with certainty for more than a few centuries.

The diamond has been found in widely separated parts of the world. Among these, Central India, Sumatra, Borneo, the Ural Mountains, California, Brazil, the Cape of Good Hope, and China have been named, in their several times, as principal localities, while it might be hard to enumerate all the minor sites. The Greeks said it was found in Ethiopia. The Indian mines are certainly of very high antiquity, for the stones are mentioned in the "Mahabaratta," and the Romans obtained their supplies chiefly from the mines of Jumalpoor, in Bengal. The Indian mines are scattered along the center of the peninsula, through 10° of latitude, from near the southern bank of the Ganges in latitude 25° to latitude 15° in the Madras Presidency. The most famous ones were those of Golconda, in the Nizam's territory, which were called after the city and fort of that name, where was the market to which they were brought, although none of them were

found there or in the near neighborhood. Nothing of the city is left, and the mines have fallen into neglect; but when Tavernier visited the district, in 1636, he found twenty-three mines in operation, employing sixty thousand men and women, girls and boys, and producing some wonderfully large and fine stones.

The mining district between the Godavery and the Mahanadi—the Adamas River of the ancients, where, it was said, "They find diamonds in quantities"—was also visited by Tavernier in 1655. The whole population were then accustomed to explore the river-bed in the late winter, when the water was low, and there was no work in the fields, and wash the diamonds from the sand.

The only mines in India now worked are at Pannah—the Panossa of Ptolemy—in Bundelcund. These also were in their day the most important diamond-fields in the world; now they are let by the local ruler to native workers, who put on an air of deep poverty, and whose greatest trouble arises from the fear that their lord may think they are becoming prosperous, and increase his charges upon them. They excuse their listlessness by averring that the tutelary deities of the soil, being irritated by the English conquest, have deserted the mines and ceased to plant them with precious stones. The rajah, however, expects at least a minimum of revenue from his mines, for, we are told, if it falls below a fixed sum, he beheads a chief and confiscates his goods. "He is cheated all the same, but he gets an actual share of one kind or another, which, without the making of an occasional example, would doubtless be denied him." The diamond industry of this country, whence nearly all the most famous crown-jewels of Europe were derived, which was once so prolific that the very mention of the name of India still awakens in the imaginative visions of untold wealth and glittering splendor, has fallen off till it is now estimated that the whole weight of Indian diamonds exported to Europe is not greater than one hundred carats a year. It was practically extinguished by the opening up of the mines of Brazil, which were discovered in 1725, and began to send in their consignments in 1730.

The first Brazilian diamonds were found by the gold-washers in the Villa do Principe, who used the crystals for counters in playing cards. A monk, who had been in India, recognized them as diamonds, and sent some of them to Europe to be cut, and thereby advertised their existence. In 1730 the diamond-fields were declared to be royal property; and from that time on, till diamonds were found in South Africa, Diamantina, in Minas-Geraes, Matto-Grosso, and the mines of the Paraguay River, were the chief sources of the world's supply. Another diamond-field was discovered in 1843, in the province of Bahia, which soon became the center of a population of thousands of seekers, and for a time yielded rich returns.

Of other famous diamond-fields—Madame Meunier records that the Chinamen in the mountains of Chinkangling collect diamonds

from the sands in the valleys by wearing slippers of straw which catch the precious stones and hold them, and then, on being burned, give them up. Diamonds in considerable quantities have been mined in Borneo, which has furnished one of the largest gems in the world, valued by the Governor of Batavia, who made the offer to the owner to be refused, at the worth of two brigs of war fully equipped and ammunitioned, plus one hundred and sixty thousand dollars. Some specimens have been found in Australia, which might have attracted more attention but for the discovery of the South-African fields, and small numbers or small crystals in nearly every other country.

The diamond-fields of South Africa are richer and more extensive than any others—so far as we know of present and have accounts of past richness—although they were only discovered less than twenty years ago. They are situated in Griqualand West, north of the Orange River, at an elevation of four thousand feet above the sea, six hundred and ten miles from Cape Town, and four hundred and eighty miles from Port Elizabeth. They might have been found long before they were, for the place was marked on a French mission-map of 1750 with the phrase "*Ici sont des diamants*" ("Here there are diamonds"), but that had long been lost sight of or disregarded. The rivers of the region had been resorted to by the natives and their ancestors for perhaps generations, for crystals with which to bore their weighting-stones, but no account seems to have been taken of that fact. Van Niekerk's children at Barkly, on the Vaal, and De Beer's at Dutoitspan, were in the habit of playing with the diamonds along with the other pretty pebbles which they found in the gravel, and no one thought the diamonds were anything more than pretty stones till one evening in March, 1867, when a trader, John O'Reilly, "outspanned" at Mr. Niekerk's farm. "O'Reilly saw a beautiful lot of Orange River stones on the table, and examined them. 'I told Niekerk,' he says, 'they were very pretty. He showed me another lot, out of which I at once picked the first diamond. I asked him for it, and he told me I could have it, as it belonged to a Bushman boy of Daniel Jacob's. I took it at once to Hope Town, and made Mr. Chalmers, civil commissioner, aware of the discovery. I then took it on to Colesberg, and gave it to the acting civil commissioner there, for transmission to Cape Town to the high commissioner.'" Another account says that O'Reilly and Niekerk tried the stone on the window, and scratched the glass with scratches that are still there; and that on his way, O'Reilly was laughed at for believing that he had a diamond, and the stone was taken from him and thrown into the street, whence he had some difficulty in recovering it. This stone was sold to Sir Philip Wodehouse, for £500. Several other diamonds were obtained during the year, among them the famous "Star of South Africa," which was bought of a native for £400, and sold in Hope Town for more than £10,000; and now, cut, reduced from 83½ carats in the rough to 46½

carats, and in the jewel-case of the Countess of Dudley, is valued at £25,000. Upon the news that such a gem as this had been found, which was spread in 1869, a "rush" of diggers took place to the Orange River. It was on the Vaal, however, that they found the diamonds, and they scattered their camps for a hundred miles or so along its course, where the washings still yield more or less satisfactory returns. The importance of this district was destined to be speedily eclipsed by the discovery, in 1871, of the famous Kimberley mine—first known as the "Colesberg Kopje," or Colesberg Hill, because it was discovered by three men from Colesberg, afterward by the suggestive name of "De Beer's New Rush," and finally by its present title—and its companion mines De Beer's, Bultfontein, and Dutoitspan. These mines are situated some twenty miles south of the river-mines, in a sandy, treeless country, that contrasts most unfavorably with the green and shady valley of the Vaal, and are so placed with reference to one another that a circle three and a half miles in diameter will inclose them all.

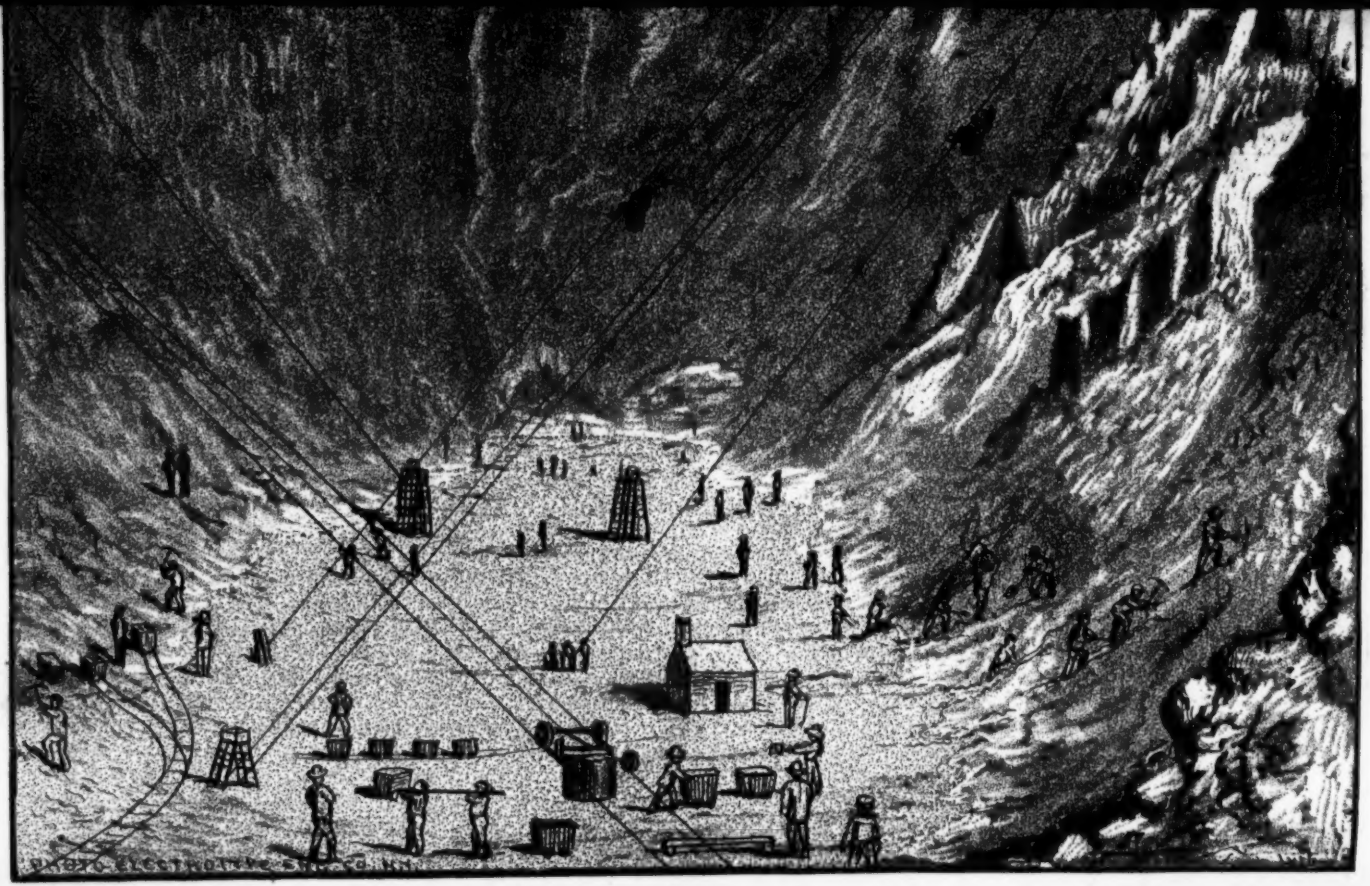
The Kimberley mine was opened to the public on the 21st of July, 1871, the allotments being made in claims thirty-one feet square. Any one could take one or two claims, but no more, for himself, on the payment of thirty shillings a month. If the claim remained unworked for a month, it could be allotted to another applicant on the same terms. A strip of seven and a half feet on one side of each claim was reserved for roadways, of which some fourteen or fifteen, each fifteen feet wide, were provided. But as the claims were worked, forming pits of greater and greater depth, the roadways soon became unsafe and began to cave in, and they eventually had to be abandoned. But the scene while they were in operation is described by Mr. Theodore Reunert, in the "Hand-Book" of the colony, which was published in connection with the recent Indian and Colonial Exhibition, as having been most picturesque: "Hundreds of carts and wheelbarrows careering along the roads, bearing their precious freight of excavated ground clear of the mine to be sorted; down below, at all distances from the surface, a succession of rectangular ledges, representing the various working-levels of different claims, where thousands of diggers and native laborers, crowded together on the narrow working-spaces, were busy picking and shoveling the ground and filling it into the original tubs and buckets of all sorts and sizes employed for conveying it to the surface; some of these were hauled up by ropes and tackle, others carried by hand up inclined planks and staircases cut in the perpendicular walls; each man worked on his own device, without regard to his neighbor, the only general rule being that the roadways must be kept intact."

After the roadways collapsed, the problem was presented of finding a way to work the large number of successive holdings, so as to preserve free access to each, and still let no claim-holder encroach or tres-

pass on his neighbor's ground. A system of haulage upon endless ropes stretched between the claims and the edge of the mine, was adopted as a temporary expedient; but this had to yield to the objections that the entire circumference of the mine did not afford frontage enough for the erection of a hauling-gear to each claim; and even if it had been enough, difficulties would have to be encountered in the crossing of the ropes. These difficulties were remedied by the erection of a system of stagings around the margin of the mine, having four or five stories of scaffolds, on which the endless ropes could be landed at different levels, the highest platforms communicating with the claims nearest the center of the mine. This arrangement gave way in time to "horse-whims," and then to steam-engines, the introduction of which was long delayed on account of the cost of transit over the five hundred miles from the coast, and of the uncertainty which prevailed whether the mines would hold out long enough to make the expenditure for them profitable.

The four principal diamond-mines of the Kimberley district have substantially the same formation. They are like bowls of diamond-bearing earth lying in a funnel-shaped inclosure of unknown depth. The surface of the whole country is covered with red, sandy soil, varying from a few inches to about two feet in depth; underneath this is a thin layer of calcareous tufa, never extending beyond a few feet in thickness. Both of these layers are of recent date, or even still in course of formation, and are general. Beneath them, the distinction between the mine formation proper and the outside rocks or "reef," first becomes apparent. The next general formation going down, in which the diamond-bearing funnel is hollowed out—the "reef" of the miners—is a shale, yellow, or colored from gray to pink, the "upper reef" extending to a depth of from thirty-five to fifty feet, beneath which is a black carbonaceous shale, running to from two hundred and sixty to two hundred and eighty-five feet below the red sand, where it gives place to an amygdaloid dolerite, identical with the bed-rock at the Vaal River diggings.

The diamond-bearing soil is, for the first hundred feet down, soft and friable, of a yellowish color, and crumbling as soon as it is exposed to the air. At about this level, although there were variations in the depth on different claims, the character of the rock all at once changed, and it became hard and of a slate-blue color. This feature caused a panic among the miners, for they at once presumed that the bottom of the diamond-deposit had been reached. They, however, treated the matter in a business sort of way, as things are said to be done in the exchanges where speculation rages. According to the story, as told by Mr. George J. Nathan, in "Longman's Magazine," "the claim-holders determined to say nothing about their discovery, but to go at once and try to sell their claims to unsuspecting diggers. Several of them accordingly put back the diamondiferous soil to the depth of a few feet, and



INTERIOR VIEW OF THE KIMBERLEY DIAMOND-MINE.

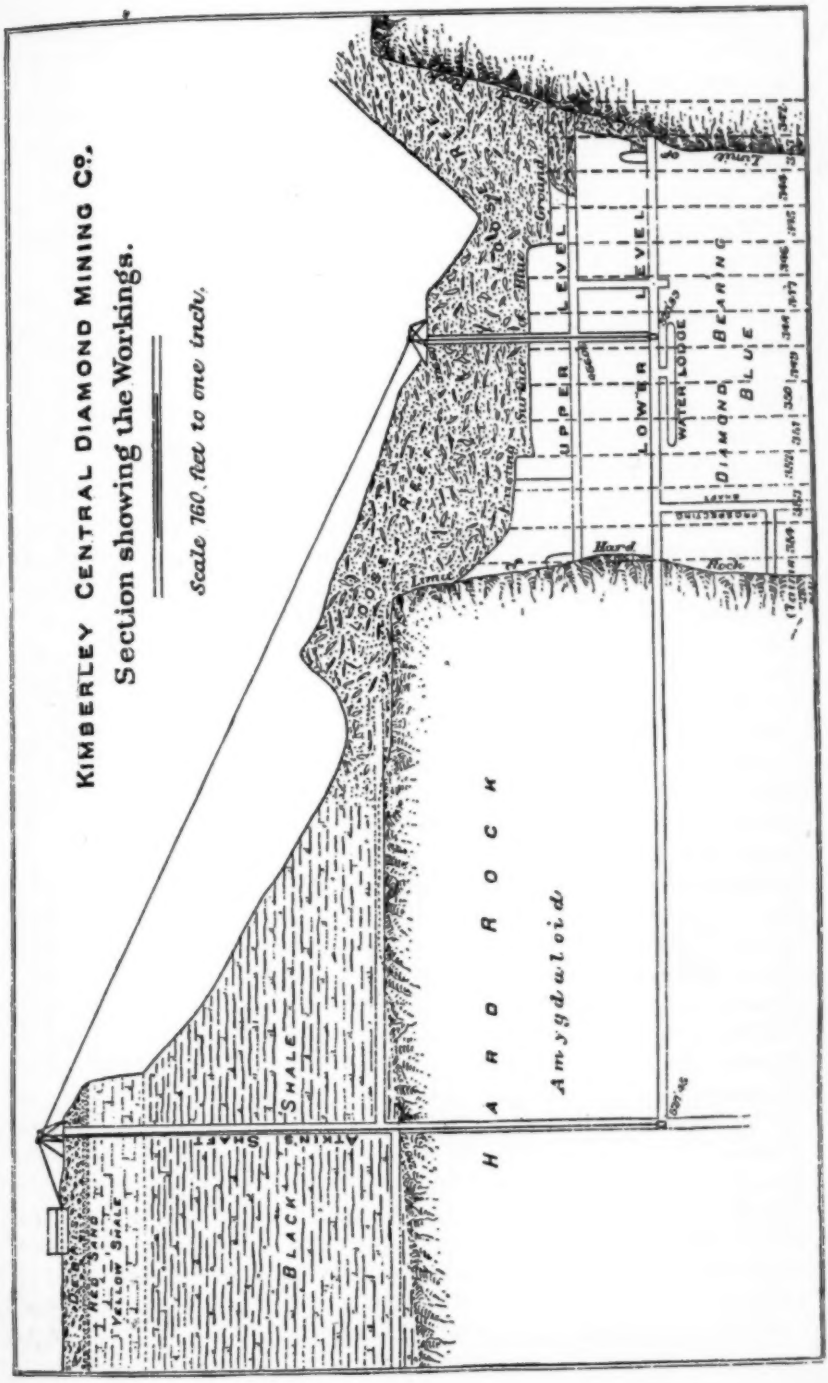
sold the claims at the ruling prices, which were then, in 1872, fifty to one hundred pounds per claim. Naturally the purchasers found (as they thought) that they had been sold, and they in their turn again planted "the claims on some more of their brother-diggers." A few, however, held their claims on the chance of something turning up, and they had their reward; for, before long, "some one had cut through this hard blue rock and hauled it from the mine into the air. Here it was left for some time exposed to the rays of the sun and the dews and rains of heaven; when one day it was found to have pulverized into a kind of mixed soil, consisting of iron-stones, pieces of hard carbon, garnets, flakes of mica, quartz-crystals, iron pyrites, peridot basalt, and what was not expected, diamonds! Yes, imbedded in this compact mass were numbers of diamonds far exceeding in quantity and quality anything taken from the upper stratum of yellow soil. Diggers had only been scratching the outer skin of the great Kimberley mine." The "yellow ground" is now known to be only the blue ground, which has been changed in color and consistency by exposure to the atmosphere; and the character of the "blue" has not shown any alteration, except that it has become harder and more crystallized, at the depth of six hundred feet, to which the lowest sinkings have been extended. The rock itself is described, generally, as a hydrous magnesian conglomerate, with silica as a base; but it is added that its precise nature is still doubtful, and "a catalogue of all it contains would fill a page." In the shale on the south side of the mine a lump of coal was discovered, and within the mine itself charred-wood fossils have been found. Thin veins of calc-spar are of frequent occurrence. Vaalite, mica, iron pyrites, and hornblende, are disseminated through the 'blue,' besides fragments and masses of shale, sandstone, and bowlders of dolerite."

The working of the mines has been seriously impeded and made vastly more expensive by the treacherous nature of the "reef," or formation of yellowish and blue shale with which its upper part is surrounded. Wherever this rock is exposed it becomes disintegrated, and is then liable to slip down at any time, like a land-slide, upon the miners working beneath it, covering up their claims and making it extremely difficult as well as dangerous to work in them; for the removal of such masses as came down soon grew to be a formidable task. In fact, the mine has not yet fully recovered from the troubles which this reef has imposed upon its workers. These most affected the claim-holders near the margin of the mine. At the same time those near the center were embarrassed by the accumulation of water in their holdings. "It soon became a recognized principle that both reef and water should be treated as common enemies, and accordingly a general rate was levied upon the whole mine to deal with them." To work more effectually with the reef-removal, the Mining Board erected costly hauling machinery on two of the corners of the mine, and sank

a large vertical shaft through the reef at the northeast corner some two hundred yards back from the limit of the claim-ground. The shaft, however, was stopped as soon as the hard rock was reached at two hundred and eighty-six feet below the surface. Tramways were laid to take the place of the carts that had been used, and the capacity of all the machinery for removing material was greatly increased. Early in 1878 one quarter of the claims were covered by reef, which was hauled out at an expense of four shillings per load of sixteen cubic feet. In 1879–'80 the board expended £300,000 on the removal of reef, *débris*, and water; in 1881, £200,000; and in 1882, more than £500,000, while claims were still covered, and other slips were impending. Although at the beginning of 1883 three shafts, one of them four hundred and fifty and another six hundred and fifty feet deep, had been sunk to assist the process, the removal of reef did not keep pace with the constantly recurring slips; and the board having spent £650,000 in eighteen months, and laboring under a deficit of £250,000, could not get its bills discounted. Consequently a "Black Friday" came to the mines, and the value of their shares fell by fifty, seventy-five, and ninety per cent; and holders of shares on which calls were liable to be made "would have been only too glad to have paid men to take them over, so as to free themselves from the liability which they were incurring."

The discovery of the hard rock, says Mr. Reunert in his report, practically confined the reef difficulty within manageable limits, as there is little doubt that this rock will stand without disintegrating, even when exposed to a great depth. But the experience of successive reef-slips has considerably increased the estimate of the shale to be removed to render the mine safe for working on the open or quarry principle. It was at first supposed that the reef would stand if cut back to an angle of 60° receding from the mine; then 45° was spoken of as the angle of repose; but it has now been found that an angle of 30° will be needful. The cost of removing this obstruction has been vastly increased by the failure to apply comprehensive and systematic plans in the beginning; but this failure is apologized for by saying that no one knew what the future of the mine would be, or was ready to venture at once upon so large a permanent outlay as would be required.

The area of the Kimberley mine, originally inclosed within the reef, was about eleven acres. Successive slips and removal of reef have widened the area till it is now twenty-five or thirty acres. The inclosing rocks which form the walls of the diamond-bearing "pipe" converge inward from the surface downward, so that the area of claim-ground is constantly reduced as the mine deepens; but in some of the lowest sinkings, which have gone to more than six hundred feet below the surface, the rock has been found to recede from the mine, and thus to permit the regaining of a certain area of rich ground.


KIMBERLEY CENTRAL DIAMOND MINING Co.
Section showing the Workings.
Scale 760 feet to one inch.
Surface
Blue Ground
UPPER LEVEL
LOWER LEVEL
WATER LODGE
DIAMOND BEARING BLUE
Hard Rock
HARD ROCK
Amygdaloid
SHALE
BLACK SHALE
YELLOW SHALE
RED SHALE

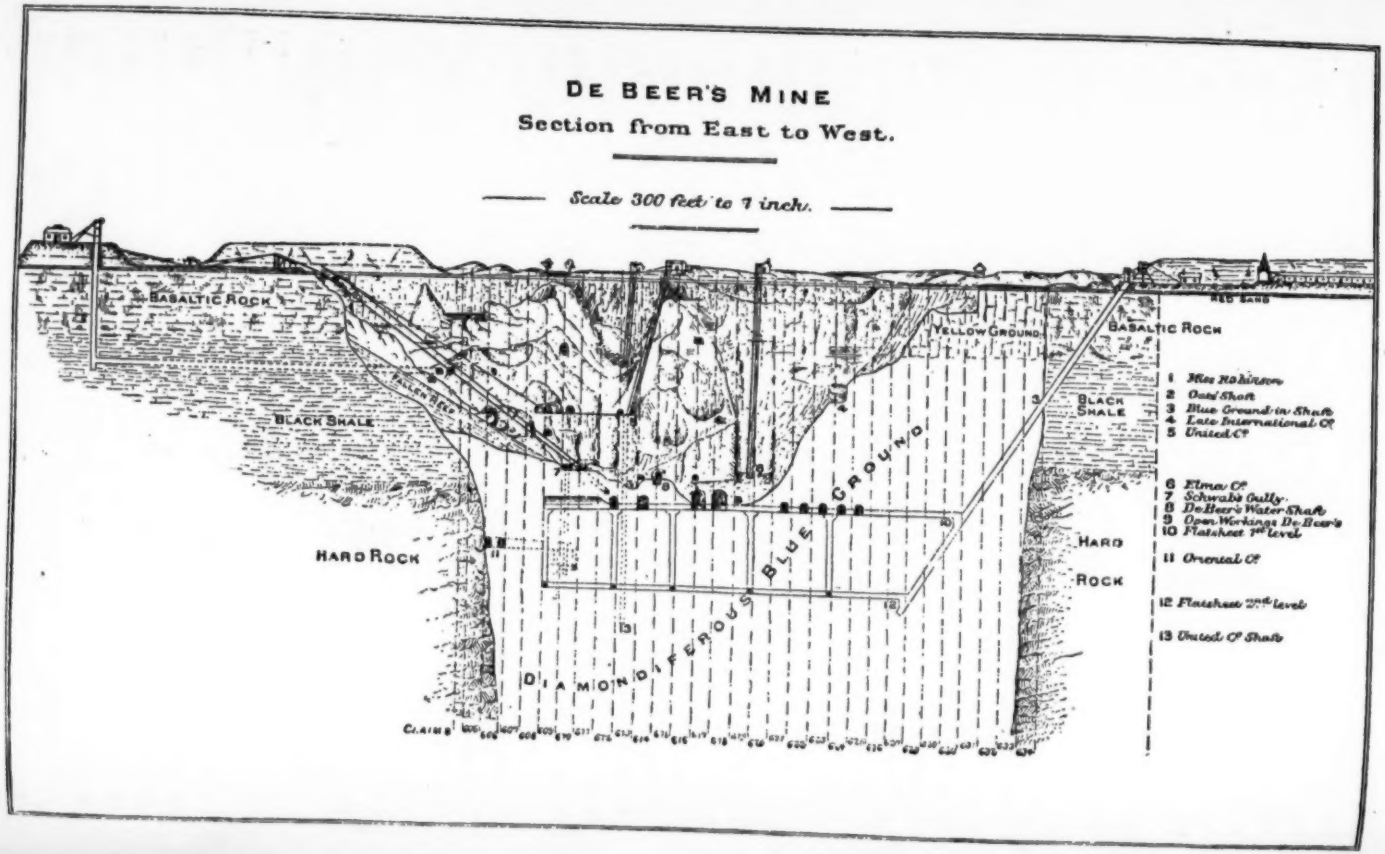
The difficulties caused by the reef have been at last overcome without having first to remove the accumulation of material by the adoption of a system of shafts and tunnels which is called, after its inventor, "Jones's system." A shaft was sunk through the fallen reef within the mine by letting down a series of caissons till the solid "blue ground" was reached. A hundred feet of loose reef was thus penetrated, after which the shaft could be extended to any desired depth in the "blue," and tunnels driven in all directions, so as to continue the excavation of the mine underground. The scheme had the merit of entailing little initial outlay, while, as soon as the "blue" was reached, the work of opening up the galleries more than paid for itself in the value of the ground removed. Other shafts have been sunk outside of the mine, one being more than five hundred and twenty feet deep, and others going down to the hard rock, and connected by tunnels and cross-tunnels, so built that the cross-tunnels have a wall of hard rock on one side, while the roof and other side are solid "blue." The excavation, says the report, "is then continued by cutting down the 'blue' from the roof overhead; but instead of trucking away the 'blue' as it falls, the rails in the tunnel are taken up and the 'blue' is allowed to pack underfoot, the miners therefore being continually climbing to a higher level, while the height of the tunnel remains uniform, just enough for the miners to be 'in touch' with the roof." In order to preserve safe means of access and egress for the workers in this continually rising chamber, a couple of cross-headings are driven parallel with it, five feet high by four wide, branching out at right angles from either side of the main tunnel, and leaving a solid wall of "blue" ten feet thick between the cross-headings and the main chamber. "A number of inclined passes are then driven at a sharp angle through this wall of blue, connecting the cross-heading with the working-chamber, and where they strike the latter vertical 'pass-pits' are carried up, rising simultaneously with the chamber, and separated from it by a three-inch plank, which prevents the loose pack of blue from filling the passes. At last the overhead excavation has proceeded so far as nearly to strike the fallen reef which at present covers all the open workings in the mine. The crown of the chamber is then broken through at either end, and the loose reef allowed to enter and pack on the top of the excavated blue. A sliding-door in the planks at the bottom of the pass-pits is then opened and the excavated blue drawn off, sliding down the inclined passes into trucks in the cross-headings, which convey it through the main tunnel and shaft to the surface. As the blue is drawn off, the loose reef above it subsides and takes its place till the chamber is entirely emptied of blue and filled with reef. The sliding-doors are then closed, and the excavation of that chamber is complete." This process is repeated, with modifications in the several chambers as they are successively excavated; while in another part of the mine an opposite system of excavation is suc-

cessfully conducted. A shaft is sunk in the blue to a total depth of five hundred and twelve feet below the red soil, and two sets of workings are opened up—one at this lowest level in course of preparation, while a first level eighty feet higher is now being worked out. At each level two sets of tunnels are used, one above the other, at a vertical distance of fifty feet apart. The upper tunnels give the level at which the excavation of large chambers is begun; and these are gradually worked downward, the roof being left untouched, while the excavated ground is delivered down vertical passes to the trucks in the lower or main tunnel.

The De Beer's mine is similar in formation to the Kimberley mine, but about one fifth larger in area. The reef incasing it for a depth of one hundred feet is a yellow basalt, after which succeeds a layer of black shale, extending to a total depth of two hundred and ninety feet from the red sand, where the hard igneous rock is struck. Within the mine the diamondiferous soil is "yellow ground" to a depth of one hundred feet from the surface, after which follows an unknown depth of "blue ground." As in the Kimberley mine, the richness of the ground greatly varies in the different sections. Having the advantage of the experience of the Kimberley, this mine has been steered clear of serious difficulties from reef. But some falls of reef which took place in 1883 and 1884, and a fall of nearly half a million loads of top unpayable ground, forced the claim-holders to consider some alternative to continuous working in the open mine; and it has become apparent that the future excavations must proceed underground. Five out of the seven companies holding the mine have sunk shafts within it for the purpose of reaching the "blue ground." One company has a shaft outside of the reef-margin, with a tunnel leading into the mine at a depth of one hundred and fifty feet from the surface. Another company has sunk a shaft from the outside at an angle of thirty-five degrees from the vertical to a depth of five hundred feet from the surface, from which working-galleries open at depths of five hundred and three hundred and eighty feet. This mine, like the Kimberley, is reduced in size at the cutting in of the hard rock.

The Bultfontein mine is almost circular in shape, with a diameter of about three hundred yards. It does not present equal promise to the operator with the two mines already described, and a considerable proportion of its claims are still unworked, while others have been abandoned on account of the encroachment of a mass of shale upon them.. No underground workings having been begun in it, it presents to the casual observer a better idea of the nature of the operations that have been carried on within the last ten years than any of the other three mines, and for that reason it has been chosen to furnish a model of diamond-mining for the Indian and Colonial Exhibition.

The Dutoitspan mine derives its name from the "pan," or small lake, which lies between it and the Bultfontein mine. This pan is filled


DE BEER'S MINE
Section from East to West.
Scale 300 feet to 1 inch.
BASALTIC ROCK
BLACK SHALE
FALSE REEF
HARD ROCK
DIAMONIFEROUS BLUE GROUND
CLAIMS
RED SAND
YELLOW GROUND
BASALTIC ROCK
BLACK SHALE
HARD ROCK
1 Miss Robinson
2 Cecil Shaft
3 Blue Ground in Shaft
4 Late International Co
5 United Co
6 Kimas Co
7 Schwabs Gully
8 De Beer's Water Shaft
9 Open Workings De Beer's
10 Fleischer 7th level
11 Oriental Co
12 Fleischer 2nd level
13 United Co Shafts

by surface drainage after heavy rains, and sometimes covers fifty or sixty acres, when good boating and wild-duck shooting may be had upon it, but in times of drought it is entirely dry. The water of the pan, and of another body, Blankenberg's Vley, is leased by the diggers for mining purposes. Except that it is semicircular instead of being circular or oval, the description of the Dutoitspan is very similar to that of the other mines.

The gems were extracted from the earth, at the beginning, when everything was crude and done in haste, and when water was scarce, by the method of "dry-sorting," which consisted in sifting the excavated ground through hand-sieves, and then passing the finer portions over a sorting-table. By this method as many diamonds were missed as were found, and frequently the yield from the rewashing of the earth over which the process had been performed gave better returns than were gained in the first instance. A modification of the "cradle" was then introduced, but it eventually gave way to the "Rotary Washing-Machine," which is still generally employed. It consists of an annular-shaped pan, from eight to fourteen feet in diameter, which is closed by an outer and an inner rim, of which the inner rim is about four feet in diameter, and is not so high as the outer rim. A vertical shaft rotates in the center of the open space, carrying ten arms radiating around it, each of which has half a dozen vertical knives, or teeth, set within half an inch of scraping the bottom of the pan. The diamondiferous ground, mixed with water, enters through an orifice in the outer rim of the pan, and is stirred up into a ripple by the revolving knives, whereby the lighter stuff comes to the surface and continually floats away through an orifice in the inner rim, while the heavier gravel falls to the bottom of the pan. The mud, or "tailings," which flows to waste over the inner rim, is led by a shoot to a pit, whence it is lifted by a chain and bucket elevator some twenty or thirty feet high. At the top of the elevator the buckets deliver the tailings onto suitable screens, over which the solid mud runs to waste, while the muddy water is led back by an overhead shoot to the machine to assist in forming a puddle of sufficient consistency to float the lighter stones in the pan, and allow only the heaviest ground to accumulate at the bottom. For the better mixing of this puddle, an inclined cylindrical screen is fixed above the level of the pan. The dry ground from the mine is tipped into the upper end of the screen, where it is met by the muddy water from the elevator and a certain amount of clear water. The large stones, of a size unlikely to include diamonds, roll out at the lower end of the cylinder, but the puddle, carrying all the smaller stones with it, passes through the wire netting of the screen and down a shoot into the pan, as above described. At the end of the day's work the machine is stopped, and the contents of the pan, after they have undergone an intermediate cleaning in a cradle, or in a small gravitating machine, called a "pulsator," are emptied upon the sort-

ing-table. The "pulsator" is also often so employed as to dispense with the "panning" process.

At the "river-diggings" (on the Vaal) the diamondiferous deposit is imbedded between bowlders and mixed with fine red sand, and sometimes with lime. The diamonds are separated by sifting the earth through a machine called a "baby"—a kind of swinging sieve, which, the coarser pebbles having been taken out by another sieve impending above it, allows the medium-sized pebbles, supposed to contain diamonds, to roll into a tub, while the finer refuse sand passes through its meshes. The contents of the tub are then gravitated, and the heavier stones are turned upon a "sorting-table," and the diamonds picked out by careful scraping. An experienced digger can tell at a glance, from the appearance of the deposit, what chance there is of "finding well" in it. He knows by sight the heavier stones that occur in diamond-bearing ground, and their presence is a sure sign of diamonds being there too. This is particularly the case with a curiously marked pebble that is streaked with a succession of parallel rings, from which it has received the descriptive name of "banddoom" (bandround). The specific gravity of the "banddoom" is almost identical with that of the diamond, and, where the former is found, experience has taught that the latter may be confidently expected. Beautiful agates are also found in this deposit, as well as quartz-crystals, jaspers, chalcedony, but few garnets, and no iron pyrites or carbon, which occur so plentifully in the Kimberley mines. An assortment of "river-stones" forms a very pretty collection, and it is conceivable enough that, prior to the opening of the diggings, diamonds should have been picked up by the natives and valued as more than ordinarily pretty pebbles. The river-digging is, however, not very profitable in the face of the large returns given by the Kimberley mines, and is now relatively of but little importance.

The whole number of claims in the four mines of Kimberley and Beaconsfield is 3,238, covering about seventy acres of diamondiferous gravel. The whole property is assessed at £5,172,975, or at the rate of £75,000 per acre, and is divided among ninety-eight holders, forty-two of whom are joint-stock companies, and the remaining fifty-six private firms and individuals. The gross capital of the joint-stock companies, which hold 2,211 claims, is returned at £7,970,490; and that of the private holders is estimated at £1,624,900, making the gross capital of the entire mines £9,595,390. The annual expenditure in labor, material, etc., is not less than two million sterling, or ten million dollars. It has been estimated, by the comparison of information from various official sources, that the gross value of diamonds exported from the Cape Colony up to the end of 1885, exclusive of such as were not reported or were illicitly taken away, amounted to £35,000,000. The total yield of diamonds from the Vaal River to date has probably exceeded £2,000,000.

In quality the Vaal River stones are rated highest, in the degree that while in the three years ending with August, 1885, the weight of those sent away from that district was only about $\frac{1}{12}$, that of the entire exports their declared value was as much as $\frac{1}{6}$ of the total value exported. Of the four Kimberley and Beaconsfield mines, Dutoitspan produces the finest stones, ninety per cent being perfect. Bultfontein comes next, with its beautiful white stones, weighing from a quarter of a carat to two carats. De Beer's comes next, and Kimberley last. In absolute value of production, the order is, Dutoitspan, De Beer's, Kimberley, Bultfontein. The largest diamond ever found in Griqualand West was an irregular octahedron from Dutoitspan, slightly spotted, and of yellow color, which weighed 404 carats, or nearly three ounces. The only larger stone than this known to have ever been found was a very imperfect one, discovered near Jagersfontein, which weighed about 500 carats. Another diamond, of 352 carats, has been found at Dutoitspan. The largest stone ever found at Bultfontein weighed a little more than 150 carats. The Bultfontein diamonds, while superior in color to all others except those of Jagersfontein, are of smaller average size than those of the other three mines.

All the diamonds coming from the various South-African mines are said to have a distinct personality, by means of which experts can at once recognize stones from either of the four mines, and tell from which it came, and can again distinguish those of the Kimberley and Beaconsfield mines from those of the river-diggings, and their testimony on this point is accepted by the courts.

All the theories by which the attempt is made to account for these mines recognize them as of volcanic origin. Their form suggests at once the crater of an extinct volcano, or the tube of a geyser. When the attempted explanation goes beyond this, the range of diverging opinions is quite wide. Of these various views, we will refer only to the observation of Sir Henry Roscoe, that the most noteworthy feature of the diamond-bearing rocks of Kimberley is the discovery in the diamond-earth of a volatile crystalline hydrocarbon, soluble in ether, which seems to confirm the hypothesis that the carboniferous shales, which are penetrated by the diamond-bearing pipes, have been the source of the carbon now found in the crystalline state in this gem. The physical structure of the ash, or incombustible portion of the stone, is of a very singular character, and has hitherto not been examined. A careful study of it may possibly throw light on the important question of the mode of formation of the diamond.

MATERIALISM AND MORALITY.

By W. S. LILLY.

"WORDS are grown so false that I am loath to prove reason with them," says Viola in "Twelfth Night." The saying constantly comes to my mind in dealing with the philosophical controversies of the present day. Rigorous definition, careful analysis, precise classification, are no longer in favor. It is an age of loose thinking, and of looser writing; of "idle words, servants to shallow fools." Never, perhaps, was there an age in which the trade of the sophist, whose business it is "to make the worse reason appear the better," was carried on so successfully. Never was there an age in which a writer who feels that he is "a teacher, or nothing," had greater need of well-considered and accurate language. Hence it is that in the papers which I have from time to time contributed to this "Review" I have sought, before entering upon my argument, to state clearly the sense in which I employ my principal terms. Most necessary is it that I should do this in respect of such a word as materialism. There are those who would restrict it to a doctrine which is now discredited for higher minds. What we know of living forces, of the real properties of bodies, has made an end of the old notion of matter reduced merely to solidity and extension. Our better acquaintance with the physiology of the sense-organs has been fatal to the sensism which Professor Clifford contemptuously calls "the crass materialism of the savage." It lingers, indeed, in the lower intellectual regions. Nay, more, it is still widely held there. "Il y a des morts qu'il faut tuer encore." And this is one of them. My present point, however, is that this coarse and vulgar theory is by no means the only form of materialism. Nor is it the form under which materialism is most potently working in the world just now. The more subtile doctrines which have arisen upon the ruins of the old materialistic hypothesis are, in all essentials, identical with it. Positivism, determinism, and much that passes current as agnosticism, are mere varieties of materialism; sublimated expressions of it, perhaps, but true expressions, having in them the root of the matter. Now here I am conscious of a difficulty. Is it fair, one may be asked, to impose the name of materialist upon those who, more or less energetically, repudiate it? I think it is fair, and, more, that it is a duty, if the name truly describes them. Take, for example, the late Mr. Clifford. As we have just seen, he rejects emphatically "the crude materialism of the savage," but only to substitute a materialism which is, indeed, more refined, but which is also, as it seems to me, more irrational. His biographer, Mr. Frederick Pollock, claims that his view is, in truth, "idealistic monism, a very subtile form of idealism," and points out that his con-

ception of the ultimate reality is "mind, not mind as we know it in the complex form of thought and feeling, but those simpler elements of which thought and feeling are built up." Well, of course, materialism affects to be monistic, for it seeks to explain the whole universe in terms of matter. But how is Mr. Clifford's monism idealistic? The element of which "even the simplest feeling is a complex" he calls "mind-stuff." "Matter," he tells us, "is the mental picture of which mind is the thing represented. Reason, intelligence, and volition are properties of a complex, which is made up of elements, themselves not rational, not intelligent, not conscious." Is it possible, Mr. Pollock himself being judge, to call this doctrine idealism? This "mind-stuff," which, we are told, is the thing-in-itself, of which "a moving molecule of organic matter possesses a small piece," and which, "when matter takes the complex form of a living human brain, takes the form of a human consciousness, having intelligence and volition"—how is it possible to account for this "mind-stuff" as anything but matter? Again, consider the teaching of Professor Huxley. With whatever rhetorical ornaments he may gild it, what is its practical outcome but materialism? I am well aware of his opinion that the question "whether there is really anything anthropomorphic, even in man's nature," will ever remain an open one. I do not lose sight of his recognition of "the necessity of cherishing the noblest and most human of man's emotions by worship, for the most part of the silent sort, at the altar of the Unknown and Unknowable." But, on the other hand, I remember his positive declaration that "consciousness is a function of nervous matter, when that nervous matter has attained a certain degree of organization." I remember, too, his confident anticipation that "we shall sooner or later arrive at a mechanical equivalent of consciousness, just as we have arrived at a mechanical equivalent of heat." And I do not forget that singularly powerful passage in his "Lay Sermons"—who that has once read it can forget it?—in which he enforces what he deems "the great truth," that "the progress of science has in all ages meant, and now more than ever means, the extension of the province of what we call matter and causation, and the concomitant gradual banishment, from all regions of human thought, of what we call spirit and spontaniety"; that "as surely as every future grows out of the past and present, so will the physiology of the future gradually extend the realm of matter and law until it is coextensive with knowledge, with feeling, with action." Once more. Let us turn to a teacher more widely influential, perhaps, than even Mr. Huxley. I mean Mr. Herbert Spencer. He, too, recognizes "an unknown and unknowable power without beginning or end in time." He tells us expressly in his "Psychology" that consciousness can not be a mode of movement, and that if we must choose between these two modes of being, as the generative and primitive mode, it would be the first, and not the last, which he would choose. These

sayings certainly do not sound like materialism. I think, however, that if we closely examine his writings, we shall find the persistence of force his one formula. With that he will bring for you life out of the non-living; morality out of the unethical; the spiritual out of the physical. The persistence of force! I trust it will not seem to exhibit an unappreciativeness, which I am far from feeling, of the high gifts and unwearied self-devotion of this eminent man, if I say that he has always appeared to me to belong to a class of thinkers aptly described in one of Voltaire's letters: "Des gens que se mettent, sans façon, dans la place de Dieu: qui veulent créer le monde avec la parole." But this autotheism is really materialism in disguise. If all beings, all modes and forms of existence, are but transformations of force, obeying only mechanical laws, the laws of movement—and that is what Mr. Spencer's doctrine amounts to, if there is any meaning in words—what is the universe but a senseless mechanism? Mr. Spencer, indeed, protests against the application to matter of such epithets as "gross" or "brute." He delights to expatiate on its wonderful properties; and in his latest work he speaks of "a universe everywhere alive; alive, if not in a restricted sense, at least in a general sense." Still the fact remains that Mr. Spencer seeks to interpret all things in terms of matter and motion, and holds life to be a mere result of physical forces. There are only two conceivable hypotheses open to us. Either Nature is the outcome of intellect, or intellect is the outcome of Nature. Mr. Spencer's teaching, considered as a whole, is an elaborate argument on behalf of the latter of these hypotheses. And what is this but materialism? I know that Mr. Spencer would call himself a realist. I think that Professor Huxley, in better moments "among the many workings of his mind," would call himself an idealist; and, as we have seen, the friend who has written so well about the late Professor Clifford calls him an idealistic monist. Mr. Pollock, indeed, goes on to observe, "It is hardly worth while to dispute about names, when more serious things remain for discussion." These words seem to me in themselves a revelation, not, indeed, of light, but of darkness; they give us a glimpse of chaos and the void inane. Surely names are the signs of, nay, the substitutes for, ideas; formulas summing up for us, briefly, it may be a train of reasoning, a series of sensations, a multitude of images. Unless we use them as parrots do, which, to be sure, is the habit of many people, they stand to us in the place of things. Hence the immense importance, upon which I have already touched, of exact terminology. If our nomenclature is vague, we shall be continually mistaking one thing for another. "Pantheism or pottheism—what matter, so long as it is true?" Mr. Carlyle asked. But my present inquiry is not if the teaching, whether of the late Mr. Clifford, of Mr. Huxley, of Mr. Herbert Spencer, is true, but what that teaching really is. And my contention is that all these three gifted men, whom I select as types of a

host of less famous writers widely influential on English thought, must in strictness be reckoned as materialists. All three do, in effect, express the entire man by matter, his intellectual and moral being as well as his corporal frame. All three do, in effect, restrict our knowledge to the phenomenal universe, of which consciousness and will are, for them, fortuitous or necessary products. Now I am far from asserting that there is anything to prevent us from being spiritualists in psychology, while in cosmology we accept the dynamical explanation, and confess that everywhere in the universe are forces and centers of forces. But this is a very different view from that which regards intellect as a mode of motion, or as a manifestation of physical energy. "The faculties of the mind, feeling, and will," writes Mr. Frederic Harrison, "are directly dependent upon the physical organs. To talk to me of mind, feeling, will, in the absence of physical organs, is to use language which to me, at least, is pure nonsense." Mr. Harrison's creed, it would appear, may be summed up in the simple symbol, "I believe in the brain, the viscera, and the reproductive apparatus." Deity without a stomach is inconceivable to him. This very eloquent and very positive writer has the courage of his opinions. But, as it appears to me, the doctrines of Professor Clifford, of Professor Huxley, of Mr. Herbert Spencer, in their ultimate resolution, are substantially at one with his. Whatever differences divide these illustrious men from one another, they all agree in putting aside, as unverifiable, everything which the senses can not verify; everything beyond the bounds of physical science; everything which can not be brought into a laboratory and dealt with chemically. It will be found in the long run that there are two, and only two, great schools of thought, two schools which, in common with the philosophical writers of Germany, France, and Italy, I shall denominate Spiritualism* and Materialism, until better terms are forthcoming. Spiritualism seeks the explanation of the universe from within, and with Kant holds it as a fundamental truth that the nature of our thinking being imposes our way of conceiving, of valuing, and even of apprehending sensible things. Materialism maintains that in those sensible things must be sought the explanation of our ideas and of our wills. Spiritualism postulates a First Cause possessing absolute freedom, and recognizes true causality in man also, with his endowment of limited and conditioned liberty of the will. Materialism holds that we can know nothing before the proximate and determining causes of phenomena, and demands, in the words of Mr. Huxley, "the banishment from all regions of human thought of what we call spirit and spontaneity." Spiritualism insists upon the unity of consciousness, upon consciousness of personal identity,

* The misuse of the word Spiritualism to denote a certain sect of vulgar charlatans is unfortunate, but "abusus non tollit usum." The Roman Church could hardly be expected to abandon her description of herself as Catholic and Apostolic because these adjectives have been adopted by the followers of Mr. Irving.

upon the *ichheit des Ego*—the selfhood of the Me—as the original and ultimate facts of man's existence. Materialism dissolves the Ego into a collection of sensations, makes of consciousness an accidental and superficial effect of mechanism, and exhibits man as a mere sequence of action and reaction. Spiritualism maintains the absolute nature of ethics; the immutable distinction between moral good and evil. Materialism refers everything to heredity, temperament, environment, convention. Spiritualism affirms the supersensuous, yes, let us venture upon the word, the supernatural, in man, and finds irrefragable evidence of it in

> " . . . this main miracle, that thou art thou,
> With power on thine own act, and on the world."

Materialism makes of the soul, with Professor Tyndall, "a poetical rendering of a phenomenon which refuses the yoke of ordinary mechanical laws," explains will and conscience as merely a little force and heat organized, and, in Coleridge's pungent phrase, "peeps into death to look for life, as monkeys put their hands behind a looking-glass." Such are the two great schools of thought which are disputing the intellect of the world.

Now, I take it, that one of the most striking signs of the times is the extent to which materialism has triumphed throughout Europe. Fifty or sixty years ago it might well have seemed as though Kant had made an end in Germany of the doctrine which, derived by the *philosophes* of the last century from Locke, had been carried to its logical issue by Cabanis and Condillac. In England the school of Reid was, in some sort, doing a similar work. In France the influence of Royer Collard, Maine de Biran, Jouffroy, and Cousin—all, whatever their differences, firmly attached to the main principles of spiritualism—was dominant. In Italy the works of Pasquale Galuppi had diffused some knowledge of the critical philosophy, and Rosmini's "New Essay on the Origin of Ideas" had made its way into many seminaries. Now, all is changed. In Germany a school has arisen based on the empirical doctrines supposed to have been forever discarded, but giving to them a new and more precise form. Of its many able exponents it must suffice here to mention only one, Herr Büchner, whose book on "Matter and Force" has had an immense success in his own country, and has been translated, I believe, into well-nigh all European languages. M. Janet, no mean judge, reckons it as "the tersest, frankest, and clearest system of materialism which has appeared in Europe since the famous 'Système de la Nature.'" It is true that in Germany the influence of these new materialistic doctrines would appear to be on the wane. They are not specially fitted to recommend themselves to the Teutonic mind, with its innate bias to idealism. And they have been vigorously combated by a number of extremely able writers, foremost among whom must be reckoned Lange and Von Hartmann, Ulrici and Lotze. Yet no one can carefully study

contemporary German literature without perceiving how potential still is the school which relies wholly upon the positive sciences, and puts aside entirely psychology and metaphysics. Its prevalence in England may be sufficiently indicated by merely mentioning the names of the three accomplished scientists at whose teaching we have already glanced, the late Professor Clifford, Professor Huxley, and Mr. Herbert Spencer, not to speak of Professor Tyndall. But if we would see this way of thinking have free course, if we would fully realize the inglorious liberty of the sons of matter, it is upon France that we must gaze. In that country, at the present moment, the most widely influential school is unquestionably the medico-atheistic: the school which inculcates sensism of the grossest kind, which reeks of the brothel, the latrine, and the torture-trough. "A most superficial and most degraded positivism," M. Beaussire tells us in his recent able work,* "seems to have taken possession of well-nigh all souls." A remnant, indeed, is left in the higher regions of French thought which has not bowed the knee to the Baal of dead mechanism, nor joined itself to the dung-god. In M. Caro and M. Janet, to mention no others, may be found worthy successors of Cousin and Maine de Biran. But unquestionably the two greatest intellectual forces in France at the present time are M. Renan and M. Taine, neither of whom can be claimed by spiritualism. I do not lose sight of the many magnificent passages in which M. Renan pays homage to the supersensuous, the ideal, the divine. Yet there is ever before him the haunting suspicion that, after all, Gavroche may be right—that "jouir et mépriser" may be the last word of the true philosopher. There are those who find the secret of his transitions of thought in the famous *mot* of M. Sardou's comedy, "J'ai assez pratiqué le monde pour savoir qu'on n'a jamais que la conviction de ses intérêts." There are those again who tell us that in his profound and serene intellect every passing phase of contemporary thought is reflected like the clouds in the bosom of the calm ocean. I am not ambitious to decide which explanation is the true one. It is enough for me to point to his own account of himself, which is that he does not know whether or no he is a materialist: "Je ne sais bien si je suis spiritualiste ou matérialiste. Le but du monde, c'est l'idée: mais je ne connais pas un cas où l'idée se soit produite sans matière: je ne connais pas d'esprit pur, ni d'œuvre d'esprit pur." M. Taine has of late years been most prominently before the world as the first living historian of his country, perhaps of any country. But we must not forget that his high place among contemporary thinkers was first won as a philosopher. A closely knit system his is, indeed. But what a system! A system of mechanism and fatality, dealing with the universe as an immense and

* "Les Principes de la Morale," Paris, 1885. The extremely striking introduction—whence my citation is taken—attracted much notice when it appeared originally in the "Revue des Deux Mondes" of August 1, 1884.

eternal series of visible movements, more or less complex, all reducible to invisible movements, obeying the laws of physics. Reason, intelligence, will, personality are for him mere metaphors. He reduces them all to mechanism and movement. The intellect he regards as a thinking machine, just as the stomach is a digesting machine. He will speak of the soul, if you please; but, like Mr. Tyndall, he warns you that you must take it merely as a poetical expression, a rhetorical figure. With reason did Michelet, after reading his admirably written book on Intelligence, exclaim in dismay, "Il me prend mon moi." France, after all, is still the country in which the movements of the European mind may be most fruitfully studied. If Germany is the mine of ideas, it is France which mints them and makes them current coin. Intellectually considered, Italy and Spain are merely outlying provinces of France, and her influence upon English and Teutonic thinkers, if less magisterial, is hardly less effective.

I consider, then, that if we survey the higher thought of Europe, as a whole, we must find it largely given over to materialism. And if we turn to the more popular literature, in which is the truest expression of society, the same tale is unfolded. What a portent is that large and ever-growing school of "naturalistic" fiction of which M. Zola is the honored and prosperous chief, and which is so eagerly read, and so largely imitated, throughout the civilized world! "Toute métaphysique m'épouvante" that master tells us. His works, he claims, are conceived in the true "scientific" spirit. Matter is for him the only reality, and in its honor he raises pæans "like the shrieks of a hyena at discovering that the universe is all actually carrion." But it is not merely in the literature of the erotic passion, and of the genetic impulse, that the mark of the beast is plainly visible. How many a grave writer of our day has acquired a reputation for originality simply upon the strength of a fantastic physical terminology! Instead of intellect, he speaks of nervous centers; instead of life, of the play of cellular activities; instead of mental energy, of cerebral erethism. And his readers, piquing themselves on their distrust of everything outside the sphere of what they call facts, will "wonder with a foolish face of praise." In truth, every branch of intellectual activity bears witness to the advance of materialism in the popular mind; to the dying out of the old spiritual and ideal types. Thus, in politics, we see the domination of the brute force of numbers, of majorities told by head, becoming almost everywhere an accomplished fact. The instincts and passions of the masses, who are little more than matter in motion, are accepted as the supreme law, in the place of justice and virtue, of reason and religion. Art, too, has bowed her sacred head to the materialistic yoke. It has been well remarked that in the pictures of the old masters you have not merely a natural scene, but the soul of the painter who looked upon it. That attribute of soul

is precisely what has been steadily dying out from modern art, as the physical sciences have more and more imposed their sway upon our ways of thinking and our habits of life. The true function of the artist, as of the metaphysician, is to seek the reason and essence of things. But while to the philosopher this reason and essence are revealed in a principle, in a general conception, to the artist they are revealed in a concrete form, as individual beauty. Both are seekers after truth; but the beautiful is the splendor of the true, and the sense of beauty is the light of the intellect. Materialism quenches that light. All that the artist now usually aims at is to copy exactly, to reproduce phenomena. And here, indeed, he attains some measure of success, especially if the phenomena be of the lupanarian order. Well has Mr. Ruskin pronounced the art of our own time to be "a poor toy, petty or vile." Perhaps its portraits are its most valuable achievement. But their value is rather historical than artistic; they tell their own tale about the men and women of the age. What that tale is, a distinguished French painter not long ago pointed out. They are the abstract and brief chronicle, he observed, in which is written the spiritual history of our century. During the first half of it, the neck is thrown back, the head is upturned toward heaven, as if in quest of some ideal vision. As we draw toward our own days the neck contracts, the head sinks nearer the shoulders, as though by the instinctive movement of a bull gathering himself up for the combat. It is because the battle of life has become more intense, because the mind is concentrated upon the material interests of the world. The habit of thought—curious verification of a law of Darwin's—has transformed the physical habit. A most delicate and sensitive intellect—to whom British philistinism, with its "certitude de mauvais goût," has largely paid the homage of its contumely and scorn—notes the same fact in his own way. The substitution of the laws of dead matter for the laws of the moral nature, the subjection of the soul to things, "écraser l'homme spirituel, dépersonalizer l'homme" is, as Amiel discerned, the dominant tendency of the times. It appears to me that if you survey the civilized world you find everywhere the same tokens. Everywhere I note the practical triumph of that earth-to-earth philosophy which will see nothing beyond experience, which shuts off the approach of science to all that can not be weighed and measured. Everywhere literature and art are losing themselves in the most vulgar sensuousness. Look throughout Europe, and what, in every country, are the great majority of the educated classes, who give the tone to the rest? Skeptics in religion, doubters in ethics, given over to industrialism, and to the exact sciences which minister to it, respecting nothing but accomplished fact and palpable force, with nerves more sensitive than their hearts, seeking to season the platitude of existence by a more or less voluptuous æstheticism, a more or less prurient hedonism. Such are the men of this new age. The intellectual atmosphere

is charged with materialism; and breathe that atmosphere we must, whether we will or no.

Now the question which I would invite my readers to ponder is, What, in such an age, is the prospect before us as regards those ethical conceptions upon which society has as yet existed? Can they live in this blighted air? And, without them, what will become of the moral life of mankind? Do not let us mistake the fact. We are living in a crisis of the world's history, a great crisis, for it is a moral crisis. Fifty years ago Jouffroy wrote his celebrated article, "Comment finissent les dogmes." He had in view religious dogmas only, and especially the distinctive tenets of Christianity. He might now, were he alive, discuss the question in a much wider sense. Philosophy, as well as religion, has its traditional bases. Certain it is, as mere matter of history, apart from all controversy, that the ethical ideas which have hitherto ruled the conduct of mankind, have rested upon certain metaphysical *credenda*. As certain is it that the postulates of the old philosophy—a First Cause, by which the universe was brought into existence, and that for a good end, the personality of man, his limited and conditioned liberty and moral responsibility, the immateriality and immortality of the Ego, the absolute nature of ethics—certain it is that these things are now very commonly put aside as antiquated delusions. Kant is no less discredited than St. Paul in the eyes of the prophets of materialism. The practical reason fares as badly as the Christian revelation at the hands of the sages of positivism. Nay, every newspaper hack of Continental Liberalism is ready with his gibe at M. de l'Absolu and Mdlle. l'Âme. In the novel, in the play, in the babble of the drawing-room or the dinner-table, the most august and venerable of ethical doctrines are called in question and denied. Even the supreme authority of conscience is impugned. To its "Thou must" the answer is prompt: "On what compulsion must I? tell me that!" Its "dogmatism" is contemptuously rejected, for physical science—the only science—is supposed to have given an explanation of it, fatal alike to its authoritativeness and to its coerciveness. No longer may we account of it with St. Paul, as the divine law written in the heart; no longer with Kant, as the law laid by a man's higher self upon himself. Has not Mr. Herbert Spencer resolved its obligation into a long-sighted selfishness? its sanction into a brain-track? Certain it is that every civilization which the world has as yet known, has been reared upon an ethical, not a physical foundation. A common belief in dogmas of morality—I use the word dogmas advisedly—has hitherto been the very condition of social cohesion. To speak of Europe only, its public order has ever been based upon the conviction, deep down in the hearts of all, at the very root of their moral and spiritual being, that man was encompassed by duties—duties which, however grudgingly performed or brutally violated, in countless instances, were everywhere undoubtingly recognized as the divinely imposed laws of life;

no more to be chosen by men or women, Savonarola reminds the fugitive Romola, than birthplace, or father, or mother could be chosen, though men might choose to forsake them. So long as a moral-code exists, and is generally acknowledged and revered, the fact of individual deflections from it, whether they be more or less numerous, is of comparatively small importance. It is the invalidation of the moral code, the prevalence of ethical agnosticism, the skepticism as to all first principles, which I account so portentous a sign of our own times. It seems to me to be the token of a decadent and moribund civilization.

Let us look at the matter as practical men. Assuredly what we may expect from materialism is not construction but destruction in all the most important departments of human life. Consider only two. The bond of civil society is obedience to law, fenced round with penalties; but legislation rests upon the doctrine of human responsibility. "Will," Kant tells us, "is a kind of causality belonging to living beings in so far as they are rational; and freedom is such a property of causality as enables them to be efficient agents, independently of outside causes determining them; while, on the other hand, necessity is that property of all irrational beings, which consists in their being determined to activity by the influence of outside causes." This conception of human freedom underlies the notion of crime. Yes; the sense of crime is bound up with the belief in man's power of choice, and in his obligation to choose rightly. Where there is no faculty to judge of acts, as right or wrong, and to elect between them, as in a young child or a lunatic, there is no criminal responsibility, for there are no persons. Personality manifests itself under the condition of free-will, influenced but not coerced by motives, a will which has the power of choice between two alternative courses. Without that power assuredly there is no moral acountability. *Ought* is a meaningless word without *Can*. Now, every school and variety of materialism does, in effect, deny free-will, be the denial more or less direct, more or less veiled.* Either we are presented with the *a posteriori* argument, so elaborately worked out by Buckle, which aims at establishing, by the aid of statistics, that what we call morality is subject to fixed laws, like the course of the stars or the return of the seasons; that what we call virtue and vice are the results of physical causes, as regular as those which rule the germination of plants or the procreation of animals. Or the *a priori* road is followed, and we are told that though we can determine our actions according to our wishes, we can not determine our wishes. The will—what we call will—is exhibited to us as always governed by the strongest motives, the force of which is not due to us, for we suffer them, we do

* Thus, Mr. Clifford, in words, admits man's free agency; but, in fact, he reduces it to the mere shadow of a great name. It is with him nothing but the consciousness of being attracted, not propelled.

not originate them. Do we reply: "True, indeed; but though we do not create motives we have in our own hands the culture of the will; we are the architects of our own characters, because character is formed by acts, is, in fact, a chain of acts, and it rests with us to forge the first link of that chain"? The rejoinder is: "You beg the question. That first act was determined by motives; it was produced by the influence of the strongest of the external causes. Your so-called free-will is an illusion; it is really the sum of the many influences, of various kinds, which have been brought to bear upon a man, not merely individually, but during the countless generations of his existence in his ancestors. These have given to his soul—what we poetically call soul—its characteristic ply. 'Such as we are made of such we be.' What we call virtue and vice are, in M. Taine's striking phrase, 'merely products, like sugar and vitriol.' They are mainly the outcome of heredity. Francis of Assisi was necessarily a saint. Eccelino was necessarily a monster. Alexander Borgia could not by any means have become a Savonarola, nor Savonarola an Alexander Borgia. 'A poor devil can't command courage any more than he can make himself six feet high,' says Colonel Newcome, in extenuation of the cowardice of his nephew Barnes. No; nor can he command purity, or veracity, or pitifulness. 'To doubt the necessary nature of an action when a motive is presented to a given character,' writes the German philosopher, 'is just as absurd as to doubt that the three angles of a triangle are equal to two right angles.'" The conclusion to which materialism in all its schools is inevitably led, is that will is not what Kant has defined it, but only a word to hide our ignorance of causation, a modality of instinctive acts, accompanied by a certain degree of sensation. But with what is called metaphysical liberty, with freedom of volition, merit and demerit disappear too. Human causality, human spontaneity, human responsibility, all die before the "uncreating word" of materialism. Its doctrine of absolute irresponsibility makes an end of ethics; its criminal legislation can be nothing but *leges sine moribus vanæ*. For the sting of punishment is not the actual fact—"stone walls do not a prison make"—but the moral disapprobation of which the fact is evidence. But how visit with moral disapprobation those who were incapable of doing anything but what they did? Poor victims of temperament, of heredity, of environment, they are to be pitied, not blamed; while, indeed, we seclude them for the protection of our persons and pockets; for we are the numerical majority, we can appeal to the *ultima ratio* of force, if to nothing higher. It is no fancy picture which I am now drawing. Fifty years ago Balzac wrote: "Crime has been made poetical; tears are driveled over assassins." True as his words were then, they are even truer now. The idea of law as the embodied conscience of a nation of persons, the belief in justice, in the old sense, as something quite transcending mere expediency—*fiat justitia pereat mundus*—the conception of the civil

magistrate as a minister of the retribution ordained by that justice as "the other half of crime," these things have well-nigh died out from the popular mind, as in place of the old spiritual principles of ethics, materialism refers us to natural history.

If law, with penal sanctions, be the bond of civil society, the family is certainly its foundation. But the family depends upon marriage. Now marriage, as it exists in Europe, is mainly the creation of spiritualism embodied in Christianity. Wordsworth gave utterance to no mere poetical fancy, but to the exact truth, when he wrote of "pure religion breathing household laws." What will become of marriage, and of that virtue of chastity of which it is the guardian, if we are to be governed by purely physical canons? In a recent work I have pointed out what, as a matter of fact, was the effect upon matrimony of the materialism dominant in France during the second half of the last century.* I may here note how the legislators of the first French Republic dealt with it. The National Convention reduced it to a civil contract terminable, under circumstances, by the decree of a secular tribunal. As a fitting pendant to this enactment, the law of the 12th of Brumaire, year II of the Republic, placed natural children upon a footing of almost complete equality with children born in wedlock. Cambacérès, who acted as the *rapporteur* of the measure, would, indeed, have put them upon a completely equal footing. "The existing differences," he urged, "are the result of pride and superstition; they are ignominious and contrary to justice." The materialists who now sit in the seat of those sages are bent upon continuing and completing their work. The recent law on divorce is but a beginning, quite insufficient to satisfy the aspirations of the bolder spirits who pant for the entire abolition of marriage upon the ground that it is "the tomb of love, and the chief cause of stupidity (*abêtissement*) and ugliness (*enlaidissement*), in the human race." I suppose it must be conceded that stupidity and ugliness are the rule, rather than the exception, in the human race. But I have never been able to follow the reasoning which professes to find the source of these evils in matrimony, and their remedy in sexual promiscuity. Certain it is, however, that every school of materialism tends to the substitution of ephemeral connections, of what Mr. John Morley calls, after Rousseau, "marriage according to the truth of nature"†—it is usually known as concubinage—for permanent and indissoluble wedlock, a "servitude" for which no sanction is found in physical science. "The moral and legal rule of marriage will be changed," M. Renan lately prophesied to the well-pleased students gathered around him at the *Grand-Véfour;* "the old Roman and Christian law will one day seem too exclusive, too narrow." And evidently M. Renan thinks that day of redemption drawing nigh.

* "Chapters in European History," vol. ii, pp. 153–159, second edition.

† See his account of Rousseau's mock marriage in vol. i, chap. iv, of his work on that philosopher.

Certain it is that every school of materialism, by banishing the spiritual element from love, reduces it to a mere physical function, and makes of chastity a monkish superstition. "La morale," a keen witted Frenchman observed to me the other day, "est considérée par la Révolution comme une cléricale." And the abounding obscenity of literature and art in France is viewed with satisfaction by her present rulers, as the most effective weapon wherewith to combat this dreaded foe of the Third Republic. We in England have not as yet got so far as advanced thinkers across the Channel. But unquestionably we are on the road. The establishment of the divorce court has been a heavy blow at the old spiritual conceptions of wedlock hitherto unquestioningly received among us. And who can estimate the demoralizing effect of the flood of filth vomited throughout the country from that "common sewer of the realm"? The warnings of the saintly Keble "against profane dealing with holy matrimony" have received only too ample justification. On every side we may discern the tokens how the old reverence for woman, and for that virtue of chastity which is the very citadel of her moral being, is being sapped among us, as materialism advances. The "Christian idea of purity," the Dean of St. Paul's some time ago told the University of Oxford, "has still a hold upon our society, imperfectly enough." Can we ask a more anxious question than whether this hold will continue? No one can help seeing, I think, many ugly symptoms. The language of revolt is hardly muttered. The ideas of purity, which we have inherited and thought sacred, are boldly made the note and reproach of the Christians. "Ugly symptoms," indeed, abound on every side. How largely has our popular literature lost itself in a so-called "realism," devoid of that ethical sentiment, without which, Goethe has well observed, "the actual is the vulgar, the low, the gross"! The art of the novelist in particular, how very generally is it degraded to the delineation of what the author of "Sapho"—no mean authority on such a subject—calls "ces amours de chair"; "those merely animal loves," wherein, he tells us, "there is no esteem, no respect, for the object of the passion, and brutality ever wells up, whether in anger or in caresses." Consider how the art of painting has been debased into a vehicle of mere sensuousness, a provocative of pruriency, a "procuress to the lords of hell." It is a true saying of Pope that a man shows not only his taste, but his virtue, by the pictures which hang upon walls. What a tale as to the virtue of this age do its pictorial exhibitions unfold! Or, again, think—but briefly—of the apotheosis of prostitution which is one distinctive note of our epoch. And here let me guard myself against misconception. I know well that the poor in virtue, as the poor in worldly wealth, we shall have always with us. I know that, in our present highly complex and artificial civilization, the rude proceedings, whereby the men of simpler ages sought to enforce chastity, would be out of date. I think it probable that in any age they did

more harm than good. True, emphatically, in the existing condition of society, is St. Augustine's warning "Aufer meretrices de rebus humanis, turbaveris omnia libidinibus." And, this being so, I believe the true function of the state is to control and regulate what it must regard as a necessary evil, and to minimize, as far as may be, the resultant mischiefs, moral and physical. These miserable women are the guardians of our domestic purity. The "macte virtute esto" of Cato was prompted by a true knowledge of human nature. But, at all events, the infamy of the courtesan's trade has hitherto been generally recognized. It has been reserved for the materialism of the nineteenth century to make of this unclean creature an object of admiration, of envy, nay, of respect; the heroine of drama, the type of comedy, the theme of romance, the arbitress of fashion, the model curiously and attentively studied by great ladies with daughters to marry, by *débutantes* with husbands to find. 'Hoc fonte derivata clades." One need not go very much into general society to know how widely spread the corruption is. The language of the *lupanar* is heard from virginal lips. Things which it is a shame even to speak of, are calmly discussed by beauty just out of the nursery. A taint of lubricity hangs over "society." It is as though body and soul were steeped in materialism. "Si un homme épouse une jeune femme, élevée à la moderne, il risque fort d'épouser une petite courtisane," debauched in mind, if physically intact. It is an observation of Bernard de Vaudricourt in "La Morte," and is true of other countries than France. If any one wishes to see what the woman of the future, brought up without religious or metaphysical dogmas, in the school of physical facts, accepted as the only facts, is fated to become, let him survey "Sabine Tallevaut," as she is depicted for us in the pages of that admirably written book. Nowhere has M. Feuillet displayed more signally the sagacity and acuteness of his observation of social phenomena, or his singular psychological skill. I know not whether to admire more his refinement or his audacity, his mastery of the emotions or his descriptive power. Certain it is that the morality of the world, in the long run, is determined by women. Certain it is that the philosopher was well warranted when he wrote, "ce qu'on appelle l'homme moral, est formé sur les genoux de sa mère." Certain it is that for woman the idea of duty is, as a matter of fact, inseparably bound up with the spiritual conceptions derived by her from religion. And as certain is it that, if she once lose those conceptions, nothing but lack of personal attractions, or absence of opportunity, saves her from utter ethical degradation. Let us never forget that the difference between man and woman is not merely of physical conformation. It is psychical. "Woman is not undeveloped man, but diverse." She is governed far more by instinct, by impulse, by affections, than by logic, by purpose, by principles. For her, materialism means more utter ruin than for man, for it extinguishes the ideal which is her one light of life. As it destroys the

sense of duty in man, so is it fatal to pure love in woman. Bring up woman in the positivist school, and you make of her a monster: the very type of ruthless cynicism, of all-engrossing selfishness, of unbridled passion.

There are eminent persons, I am well aware, to whom these conclusions will be extremely distasteful. Writers, whose names alone suffice to establish a claim upon our respectful attention, discourse to us of "independent morality." Professor Huxley, as I remember, somewhere protests with characteristic vehemence, "I will not for a moment admit that morality is not strong enough to hold its own." After all, however, the vital question is not what this accomplished physicist will admit, but what, from the nature of the case, is likely to happen. No doubt Professor Huxley, emancipated from belief in angel or spirit, still guides himself by the same ethical rules as before. I do not myself know anything of the early history of this illustrious man; but I suppose that, like the rest of us, he was brought up upon the Catechism. At all events I am quite sure that he is the product of many generations of Christian progenitors. What M. Renan happily calls the moral sap of the old belief—"la sève morale de la vieille croyance"—still courses through his spiritual being. His materialism takes credit for virtues springing from quite another source: "Miraturque novas frondes et non sua poma." He knows, far better than I do, the influence of heredity and of environment upon character. He is well aware how deeply rooted in the past are those ethical principles whereby human life is still largely governed, even among materialists. The question is, Can you uproot those principles and expect them to flourish upon a quite different soil? Morality in Professor Huxley, I can well believe, is strong enough to hold its own. But will it be strong enough in Professor Huxley's great-grandchildren? "It takes several generations for Christian morality to get into the blood," the missionaries in Samoa told Baron von Hübner. It will doubtless take several generations for Christian morality to get out of the blood. And then? Kant, a teacher whom Professor Huxley very highly esteems, held the existence of God and a future life to be necessary postulates of morality. Certainly, as a matter of fact, they are postulates upon which morality has hitherto rested. They have supplied the strongest incentives to duty, and to that self-sacrifice which the performance of duty usually involves. What is to take the place, in the generations to come, of those old spiritual dogmas? I do not know of any materialists who so much as profess to care for duty for its own sake. They are all agreed that personal interest or selfishness, of course enlightened selfishness, is for the future to be the foundation of ethics. It is from sympathy, they tell us, that the highest virtues must now spring. "Sympathy," they confidently maintain, "will impel us to seek the agreeable consciousness that results from the healthy exercise of the energies of our nature, and to promote it in others by

the exercise of virtue and benevolence." "A deep and intelligent sympathy with the race" is to supply the place of the old sanctions. I pity the race. There is no conceivable motive why we should trouble ourselves about the welfare of others if they are mere automatic organisms. The "agreeable consciousness that results from the healthy exercise of the energies of our nature" is grotesquely inadequate to support the old rule of right action, "Fais ce que dois, advienne que pourra." Physical science is utterly unable to supply any reason why we should "prefer a noble life before a long." If ever M. Renan, who is of the house and lineage of Balaam, the son of Beor, said a true word, it is this, "L'intérêt personnel n'inspire que la lâcheté." It is an insult to my understanding to tell me that selfishness, however sublimated, will yield the same fruits as self-sacrifice; that from natural history, from physiology, from chemistry, you can derive the elements of moral force. Justice, duty, love, are the idlest of words, if no echo come back to them from beyond the grave. "Virtue will never cease to be admirable so long as man is man," a Teutonic materialist urges. I entirely agree. But if you empty the human mammal of the ideas of God, right, responsibility, immortality, he ceases to be man. "'A had him from me Christian, and, look, if the fat villain have not transformed him ape!" And then assuredly virtue will cease to be admirable to him. Not indeed that I am now pleading for Christianity. Still less am I pleading for any special form of it. There is little in Christian morality that is exclusively Christian; and I am not prepared to assert that many of the most precious of the ethical elements of our civilization might not survive a general decay of specifically Christian dogmas. My present contention is more general. It is this: that morality can have root only in the spiritual nature of man. If from that happy soil, watered by the river of life and refreshed by the dews of heaven, you transplant it to the rocks and sands of materialism, wither and die it must. "Independent morality." Yes. I quite allow that, in a sense, morality is independent. It is independent of all systems, religious and metaphysical; of all facts, psychological or historical. It is, as Kant has so well shown—that is to me the great achievement of his philosophy—it is a formal law, transcending all persons and all conditions, and sovereign over all: a law of ideal relation, universally obligatory upon all wills. It is as absolute as are the laws of mathematics, and concerning it even God is not free; for it has its source in his nature, and "he can not deny himself." In this sense it is independent; but it is not independent of personality. How can we predicate ethicalness or unethicalness of a thing? I maintain, then, that whether morality be regarded subjectively or objectively, materialism is fatal to it. Only a person is capable of a moral act; and materialism destroys personality. No action can be obligatory, in the strict sense, unless it is binding upon us without regard to its consequences and without reference to any personal end.

But, according to the universal teaching of all schools of materialism, the true criterion of the value of an action is its pleasurable tendency. Show that it is not conducive to human gratification, and it ceases to be virtuous. Let materialism efface from the world the old spiritual dogmas on which ethics have hitherto rested, and the somber picture of the great poet of the last century will assuredly be realized:

> "Religion, blushing, veils her sacred fires
> And, unawares, Morality expires:
> Nor public flame, nor private, dares to shine,
> Nor human spark is left, nor glimpse divine."

It may be said that consequences are the scarecrows of fools; that things are what they are, and that it is our wisdom to see them as they are; that their consequences will be what they will be, and can in no way alter the facts of which they are the outcome. This is true enough, but it is not the whole truth. Consequences assuredly do deserve our attention. "Exitus acta probat" is a faithful saying, and with it accords that utterance of a diviner wisdom, "By their fruits ye shall know them." A *reductio ad absurdum* is a good logical process. Why? Because man consists in reason. And so the fact, if fact it be, as I believe, that the doctrines of materialism issue in unreason, in that "universal darkness" of which Pope prophesied, raises a strong presumption against them. If they are true, the last word of philosophy is spoken in the verse of Baudelaire, "Resigne-toi, mon âme, dors ton sommeil de brute." But to tell me that this is the conclusion of the whole matter, is in flat contradiction to my deepest and most assured certitudes. Certain to me is the reasonableness of the universe. It is cosmos, not chaos. Be its final cause immeasurably distant from our knowledge, yet every part of the process through which it moves is found, when examined, to be intelligible. "Nothing is that errs from law." There are mysteries, indeed, and locked doors, everywhere. As Hegel saw, every convex is concave, and every concave convex. But this is not contradiction nor unreason. Certain also to me is the supremacy of duty. Whatever is doubtful, of this I am ineffably sure, that right I must do, whatever the result; that on the side of right I must be, whether it triumph or not. And as certain to me is the sacredness of love. I do not speak of those *amours de chair* at which we have glanced with the French novelist, but of that passion for the ideal, which is the light of life:

> "Luce intellettual, piena d' amore,
> Amor di vero ben pien di letizia,
> Letizia che trascende ogni dolore."

But that which in my heart is love, in my conscience justice, in my intellect reason, is one and the same thing; it is the primary truth of which my whole moral being is full; and any doctrine which contradicts it is condemned already, even if it were, apparently, as well established, as materialism is, manifestly, ill established. For, in

truth, all schools of materialists are confronted with the initial difficulties of the unity of consciousness, of the individuality and permanency of the Ego. These facts, however complex and obscure—and I fully recognize their complexity and obscurity—are the stumbling-block of every school of materialists, just as they are the adamantine foundation of all spiritual philosophy. And the writer who tries to explain them away, who asks me to believe, upon his *ipse dixit*, that consciousness is a mere fortuitous result of mechanism, that thought is a mere cerebral secretion, that the Ego is a mere sensation, is a dogmatist who makes far greater demands upon my faith than any Catholic theologian or Jewish rabbi. I know not any article of any creed, which so largely taxes my credulity, as does the proposition that there can be consciousness without personality, memory without identity, duty without liberty.

No sort of compromise, no kind of *modus vivendi*, appears to me to be possible between these two schools of Spiritualism and Materialism. I admit, indeed, that we may learn much from many teachers whose theories I judge most false. Let us gladly accept their facts. Let us also narrowly scrutinize their arguments. The writers whom I have in view, however admirable in other respects, are assuredly great corrupters of words. Too often they exhibit the smallest power of distinguishing between a nude hypothesis and a proved conclusion. They omit necessary links in their reasoning, as when, for example, they pass at a bound over the unbridged gulf between automatic consciousness and deliberate volition. They tell us, perhaps not quite accurately,* that the brain is the origin of thought, and then they proceed to argue as though they had demonstrated that it is the cause of thought, and that intellect is a mere cerebral phenomenon. They talk glibly of causation, as if they knew all about it, overlooking their entire inability to analyze the causal nexus. And what shall we say of the way in which they habitually employ the term law? It really means in physics no more than "an observed uniformity of sequence or coexistence." But they give it a sort of personification, and speak of it as a cause. They confound it with necessity, forgetting that there is all the difference in the world between invariable regularity and necessary regularity. I confess—I trust I may be pardoned for so far yielding to a professional instinct—that I often put down the pompous pages of some of the most famous of them and say to myself: "If only I could have you under cross-examination for half an hour! How easy it would be to turn you inside out to show what a mass of arbitrary assumption, of confused ratiocination, of audacious sophism, all this brilliant rhetoric is!"

But let us remember that philosophy is the science of principles,

* I should prefer saying that the brain is the organ, not of thought, but of the *phantasmata* which furnish thought with materials: it is the organ of imagination in the highest sense.

and so ought to be encyclical, encyclopedic. It must no more neglect the positive sciences than the moral. "A wider metaphysic would not harm our physic" is an abundantly true warning. Equally true is it that a wider physic would not harm our metaphysic. It fills me with amazement to see the arguments still resorted to by men, learned in a fashion, and full of good-will, but quite unacquainted with the true bearings of the problems which agitate the modern mind, nay, totally devoid of the intellectual training necessary in order so much as to appreciate them. Their blindness to the signs of the times is well-nigh miraculous. They do not seem to possess even the sensitive membrane which Darwin tells us is the beginning of the eye. Who, that is at all competent to judge, can deny that the progress of the sciences during the present century has largely revolutionized the world of thought, or doubt that many old questions assume quite a new aspect in the light now shed upon them? To take one instance only, spiritualism is by no means bound up with the old dualistic conceptions which posit matter and mind as two incomprehensibly related substances, eternally alien from each other, and irreconcilably hostile. For myself, every day that I live I become more confirmed in the belief, which I expressed some years ago in this "Review," that "the old wall of partition between spirit and matter is cracking in all directions," that "we shall come to recognize a thinking substance, of which thought is the foundation, not the resultant."* Even now—in words which I gladly borrow from Mr. Romanes—may we not regard "any sequence of natural causation as the merely phenomenal aspect of the ontological reality, the outward manifestation of an inward meaning"? The reality is spiritual, the phenomenon merely the shadow and the symbol. Materialism, like all errors, is but the distortion of a truth. It is a false expression of that tendency to unity which is so marked a characteristic of the modern mind, and which is not false. A century ago Lessing pronounced ἓν καὶ πᾶν to be the last word of philosophy. Whatever exception may be taken to the formula, assuredly, it adumbrates a great verity. And as assuredly none can be further removed from the apprehension of that verity than those who, like Diderot, discern in the universe nothing but "one and the same phenomenon indefinitely diversified." Enveloped as we are, according to the profound doctrine of the old Vedic sages, in the veil of Mâya, what grosser illusion can there be than to mistake the fleeting shows apprehensible by our senses for the Self-Existent? "Of him, and through him, and to him are all things." Most near and most hidden all phenomena consist by him, all phenomena point to him, his indwelling leads us to his transcendence. "Wer darf ihn nennen?"—Who dare name him?—the poet asks.†

* See "Ancient Religion and Modern Thought," pp. 340–345, third edition.

† Compare St. Augustine: "Quid dicit aliquis, cum de Te dicit? Et væ tacentibus de Te; quoniam loquaces muti sunt."

And the question may well seem reverent when we think how men talk of the Absolute and Eternal as if he were altogether such a one as themselves, as if he were the man in the next room. Let us celebrate that higher ignorance, that *docta ignorantia*, as the mystics speak, which is the last word alike of physics, of philosophy, of religion: "Deveni in altitudinem maris et silui."—*Fortnightly Review.*

SCIENCE AND MORALS: A REPLY.

By Professor T. H. HUXLEY.

IN spite of long and, perhaps, not unjustifiable hesitation, I begin to think that there must be something in telepathy. For evidence, which I may not disregard, is furnished by the last number of the "Fortnightly Review," that, among the hitherto undiscovered endowments of the human species, there may be a power even more wonderful than the mystic faculty by which the esoterically Buddhistic sage "upon the farthest mountain in Cathay" reads the inmost thoughts of a dweller within the homely circuit of the London postal district. Great, indeed, is the insight of such a seer; but how much greater is his who combines the feat of reading, not merely the thoughts of which the thinker is aware, but those of which he knows nothing; who sees him unconsciously drawing the conclusions which he repudiates, and supporting the doctrines which he detests! To reflect upon the confusion which the working of such a power as this may introduce into one's ideas of personality and responsibility is perilous—madness lies that way. But truth is truth, and I am almost fain to believe in this magical visibility of the non-existent when the only alternative is the supposition that the writer of the article on "Materialism and Morality" in the current number of the "Fortnightly Review," in spite of his manifest ability and honesty, has pledged himself, so far as I am concerned, to what, if I may trust my own knowledge of my own thoughts, must be called a multitude of errors of the first magnitude.

I so much admire Mr. Lilly's outspokenness, I am so completely satisfied of the uprightness of his intentions, that it is repugnant to me to quarrel with anything he may say; and I sympathize so warmly with his manly scorn of the vileness of much that passes under the name of literature in these times, that I would willingly be silent under his by no means unkindly exposition of his theory of my own tenets, if I thought that such personal abnegation would serve the interest of the cause we both have at heart. But I can not think so. My creed may be an ill-favored thing, but it is mine own, as Touchstone says of his lady-love, and I have so high an opinion of the solid virtues of the object of my affections that I can not calmly see her

personated by a wench who is much uglier and has no virtue worth speaking of. I hope I should be ready to stand by a falling cause if I had ever adopted it; but suffering for a falling cause, which one has done one's best to bring to the ground, is a kind of martyrdom for which I have no taste. In my opinion, the philosophical theory which Mr. Lilly attributes to me—but which I have over and over again disclaimed—is untenable and destined to extinction; and I not unreasonably demur to being counted among its defenders.

After the manner of a mediæval disputant, Mr. Lilly posts up three theses, which, as he conceives, embody the chief heresies propagated by the late Professor Clifford, Mr. Herbert Spencer, and myself. He says that we agree "(1) in putting aside, as unverifiable, everything which the senses can not verify; (2) everything beyond the bounds of physical science; (3) everything which can not be brought into a laboratory and dealt with chemically" (page 477, preceding article).

My lamented young friend Clifford, sweetest of natures though keenest of disputants, is out of reach of our little controversies; but his works speak for him, and those who run may read a refutation of Mr. Lilly's assertions in them. Mr. Herbert Spencer hitherto has shown no lack either of ability or of inclination to speak for himself; and it would be a superfluity, not to say an impertinence, on my part to take up the cudgels for him. But for myself, if my knowledge of my own consciousness may be assumed to be adequate (and I make not the least pretension to acquaintance with what goes on in my "Unbewusstsein"), I may be permitted to observe that the first proposition appears to me to be not true; that the second is in the same case; and that, if there be gradations in untrueness, the third is so monstrously untrue that it hovers on the verge of absurdity, even if it does not actually flounder in that logical limbo. Thus to all three theses I reply in appropriate fashion, *Nego*—I say No; and I proceed to state the grounds of that negation, which the proprieties do not permit me to make quite so emphatic as I could desire.

Let me begin with the first assertion, that I "put aside, as unverifiable, everything which the senses can not verify." Can such a statement as this be seriously made in respect of any human being? But I am not appointed apologist for mankind in general, and, confining my observations to myself, I beg leave to point out that, at this present moment, I entertain an unshakable conviction that Mr. Lilly is the victim of a patent and enormous misunderstanding, and that I have not the slightest intention of putting that conviction aside because I can not "verify" it either by touch, or taste, or smell, or hearing, or sight, which (in the absence of any trace of telepathic faculty) make up the totality of my senses.

Again, I may venture to admire the clear and vigorous English in which Mr. Lilly embodies his views; but the source of that admiration does not lie in anything which my five senses enable me to dis-

cover in the pages of his article, and of which an orang-outang might be just as acutely sensible. No, it lies in an appreciation of literary form and logical structure by æsthetic and intellectual faculties which are not senses, and which are not unfrequently sadly wanting where the senses are in full vigor. My poor relation may beat me in the matter of sensation; but I am quite confident that, when style and syllogisms are to be dealt with, he is nowhere.

If there is anything in the world which I do firmly believe in it is the universal validity of the law of causation; but that universality can not be proved by any amount of experience, let alone that which comes to us through the senses. And, when an effort of volition changes the current of my thoughts, or when an idea calls up another associated idea, I have not the slightest doubt that the process to which the first of the phenomena in each case is due, stands in the relation of cause to the second. Yet the attempt to verify this belief by sensation would be sheer lunacy. Now, I am quite sure that Mr. Lilly does not doubt my sanity, and the only alternative seems to be the admission that his first proposition is erroneous.

The second thesis charges me with putting aside "as unverifiable" "everything beyond the bounds of physical science." Again, I say No. Nobody, I imagine, will credit me with a desire to limit the empire of physical science; but I really feel bound to confess that a great many very familiar and, at the same time, extremely important phenomena lie quite beyond its legitimate limits. I can not conceive, for example, how the phenomena of consciousness as such, and apart from the physical process by which they are called into existence, are to be brought within the bounds of physical science. Take the simplest possible example, the feeling of redness. Physical science tells us that it commonly arises as a consequence of molecular changes propagated from the eye to a certain part of the substance of the brain, when vibrations of the luminiferous ether of a certain character fall upon the retina. Let us suppose the process of physical analysis pushed so far that one could view the last link of this chain of molecules, watch their movements as if they were billiard-balls, weigh them, measure them, and know all that is physically knowable about them. Well, even in that case we should be just as far from being able to include the resulting phenomenon of consciousness, the feeling of redness, within the bounds of physical science, as we are at present. It would remain as unlike the phenomena we know under the names of matter and motion as it is now. If there is any plain truth upon which I have made it my business to insist over and over again it is this; and, whether it is a truth or not, my insistence upon it leaves not a shadow of justification for Mr. Lilly's assertion.

But I ask in this case, also, how is it conceivable that any man in possession of all his natural faculties should hold such an opinion? I do not suppose that I am exceptionally endowed because I have all my

life enjoyed a keen perception of the beauty offered us by nature and by art. Now, physical science may, and probably will, some day enable our posterity to set forth the exact physical concomitants and conditions of the strange rapture of beauty. But, if ever that day arrives, the rapture will remain, just as it is now, outside and beyond the physical world; and, even in the mental world, something superadded to mere sensation. I do not wish to crow unduly over my humble cousin the orang, but in the æsthetic province, as in that of the intellect, I am afraid he is nowhere. I doubt not he would detect a fruit amid a wilderness of leaves where I could see nothing; but I am tolerably confident that he has never been awe-struck, as I have been, by the dim religious gloom, as of a temple devoted to the earth-gods, of the tropical forest which he inhabits. Yet I doubt not that our poor long-armed and short-legged friend, as he sits meditatively munching his durian fruit, has something behind that sad Socratic face of his which is utterly "beyond the bounds of physical science." Physical science may know all about his clutching the fruit and munching it and digesting it, and how the physical titillation of his palate is transmitted to some microscopic cells of the gray matter of his brain; but the feelings of sweetness and of satisfaction which for a moment hang out their signal-lights in his melancholy eyes are as utterly outside the bounds of physics as is the "fine frenzy" of a human rhapsodist.

Does Mr. Lilly really believe that, putting me aside, there is any man with the feeling of music in him who disbelieves in the reality of the delight which he derives from it, because that delight lies outside the bounds of physical science, not less than outside the region of the mere sense of hearing? But, it may be, that he includes music, painting, and sculpture under the head of physical science, and in that case I can only regret I am unable to follow him in his ennoblement of my favorite pursuits.

The third thesis runs that I put aside as "unverifiable" "everything which can not be brought into a laboratory and dealt with chemically"; and once more, I say No. This wondrous allegation is no novelty; it has not unfrequently reached me from that region where gentle (or ungentle) dullness so often holds unchecked sway—the pulpit. But I marvel to find that a writer of Mr. Lilly's intelligence and good faith is willing to father such a wastrel. If I am to deal with the thing seriously, I find myself met by one of the two horns of a dilemma. Either some meaning, as unknown to usage as to the dictionaries, attaches to "laboratory" and "chemical," or the proposition is (what am I to say in my sore need for a gentle and yet appropriate word?)—well—unhistorical.

Does Mr. Lilly suppose that I put aside as "unverifiable" all the truths of mathematics, of philology, of history? And, if I do not, will he have the great goodness to say how the binomial theorem is to

be dealt with "chemically," even in the best appointed "laboratory"; or where the balances and crucibles are kept by which the various theories of the nature of the Basque language may be tested; or what reagents will extract the truth from any given history of Rome, and leave the errors behind as a residual calx?

I really can not answer these questions, and unless Mr. Lilly can, I think he would do well hereafter to think more than twice before attributing such preposterous notions to his fellow-men, who, after all, as a learned counsel said, are vertebrated animals.

The whole thing perplexes me much; and I am sure there must be an explanation which will leave Mr. Lilly's reputation for common sense and fair dealing untouched. Can it be—I put this forward quite tentatively—that Mr. Lilly is the victim of a confusion, common enough among thoughtless people, and into which he has fallen unawares? Obviously, it is one thing to say that the logical methods of physical science are of universal applicability, and quite another to affirm that all subjects of thought lie within the province of physical science. I have often declared my conviction that there is only one method by which intellectual truth can be reached, whether the subject-matter of investigation belongs to the world of physics or to the world of consciousness; and one of the arguments in favor of the use of physical science as an instrument of education which I have oftenest used is that, in my opinion, it exercises young minds in the appreciation of inductive evidence better than any other study. But while I repeat my conviction that the physical sciences probably furnish the best and most easily appreciable illustrations of the one and indivisible mode of ascertaining truth by the use of reason, I beg leave to add that I have never thought of suggesting that other branches of knowledge may not afford the same discipline; and assuredly I have never given the slightest ground for the attribution to me of the ridiculous contention that there is nothing true outside the bounds of physical science. Doubtless people who wanted to say something damaging, without too nice a regard to its truth or falsehood, have often enough misrepresented my plain meaning. But Mr. Lilly is not one of these folks, at whom one looks and passes by, and I can but sorrowfully wonder at finding him in such company.

So much for the three theses which Mr. Lilly has nailed on to a page of this "Review." I think I have shown that the first is inaccurate, that the second is inaccurate, and that the third is inaccurate; and that these three inaccurates constitute one prodigious, though I doubt not unintentional, misrepresentation. If Mr. Lilly and I were dialectic gladiators, fighting in the arena of the "Fortnightly," under the eye of an editorial lanista, for the delectation of the public, my best tactics would now be to leave the field of battle. For the question whether I do, or do not, hold certain opinions is a matter of fact, with regard to which my evidence is likely to be regarded as conclusive—at least until

such time as the telepathy of the unconscious is more generally recognized.

However, some other assertions are made by Mr. Lilly, which more or less involve matters of opinion whereof the rights and wrongs are less easily settled, but in respect of which he seems to me to err quite as seriously as about the topics we have been hitherto discussing. And the importance of these subjects leads me to venture upon saying something about them, even though I am thereby compelled to leave the safe ground of personal knowledge.

Before launching the three torpedoes which have so sadly exploded on board his own ship, Mr. Lilly says that with whatever "rhetorical ornaments I may gild my teaching," it is "materialism." Let me observe, in passing, that rhetorical ornament is not in my way, and that gilding refined gold would, to my mind, be less objectionable than varnishing the fair face of truth with that pestilent cosmetic, rhetoric. If I believed that I had any claim to the title of "materialist," as that term is understood in the language of philosophy and not in that of abuse, I should not attempt to hide it by any sort of gilding. I have not found reason to care much for hard names in the course of the last thirty years, and I am too old to develop a new sensitiveness. But, to repeat what I have more than once taken pains to say in the most unadorned of plain language, I repudiate, as philosophical error, the doctrine of materialism as I understand it, just as I repudiate the doctrine of spiritualism as Mr. Lilly presents it, and my reason for thus doing is, in both cases, the same; namely, that, whatever their differences, materialists and spiritualists agree in making very positive assertions about matters of which I am certain I know nothing, and about which I believe they are, in truth, just as ignorant. And further, that, even when their assertions are confined to topics which lie within the range of my faculties, they often appear to me to be in the wrong. And there is yet another reason for objecting to be identified with either of these sects; and that is that each is extremely fond of attributing to the other, by way of reproach, conclusions which are the property of neither, though they infallibly flow from the logical development of the first principles of both. Surely a prudent man is not to be reproached because he keeps clear of the squabbles of these philosophical Bianchi and Neri, by refusing to have anything to do with either?

I understand the main tenet of materialism to be that there is nothing in the universe but matter and force, and that all the phenomena of Nature are explicable by deduction from the properties assignable to these two primitive factors. That great champion of materialism whom Mr. Lilly appears to consider to be an authority in physical science, Dr. Büchner, embodies this article of faith on his title-page. *Kraft und Stoff*—force and matter—are paraded as the Alpha and Omega of existence. This I apprehend is the fundamental

article of the faith materialistic; and whosoever does not hold it is condemned by the more zealous of the persuasion (as I have some reason to know) to the Inferno appointed for fools or hypocrites. But all this I heartily disbelieve; and, at the risk of being charged with wearisome repetition of an old story I will briefly give my reasons for persisting in my infidelity. In the first place, as I have already hinted, it seems to me pretty plain that there is a third thing in the universe, to wit, consciousness, which, in the hardness of my heart or head, I can not see to be matter or force, or any conceivable modification of either, however intimately the manifestations of the phenomena of consciousness may be connected with the phenomena known as matter and force. In the second place, the arguments used by Descartes and Berkeley to show that our certain knowledge does not extend beyond our states of consciousness, appear to me to be as irrefragable now as they did when I first became acquainted with them some half-century ago. All the materialistic writers I know of who have tried to bite that file have simply broken their teeth. But, if this is true, our one certainty is the existence of the mental world, and that of *Kraft und Stoff* falls into the rank of, at best, a highly probable hypothesis.

Thirdly, when I was a mere boy, with a perverse tendency to think when I ought to have been playing, my mind was greatly exercised by this formidable problem, What would become of things if they lost their qualities? As the qualities had no objective existence and the thing without qualities was nothing, the solid world seemed whittled away—to my great horror. As I grew older, and learned to use the terms matter and force, the boyish problem was revived, *mutato nomine*. On the one hand, the notion of matter without force seemed to resolve the world into a set of geometrical ghosts, too dead even to jabber. On the other hand, Boscovich's hypothesis, by which matter was resolved into centers of force, was very attractive. But when one tried to think it out, what in the world became of force considered as an objective entity? Force, even the most materialistic of philosophers will agree with the most idealistic, is nothing but a name for the cause of motion. And if, with Boscovich, I resolved things into centers of force, then matter vanished altogether and left immaterial entities in its place. One might as well frankly accept idealism and have done with it.

I must make a confession, even if it be humiliating. I have never been able to form the slightest conception of those "forces" which the materialists talk about, as if they had samples of them many years in bottle. They tell me that matter consists of atoms, which are separated by mere space devoid of contents; and that, through this void, radiate the attractive and repulsive forces whereby the atoms affect one another. If anybody can clearly conceive the nature of these things which not only exist in nothingness, but pull and push there with great vigor, I envy him for the possession of an intellect of larger

grasp, not only than mine, but than that of Leibnitz or of Newton.* To me the "chimæra, bombinans in vacuo quia comedit secundas intentiones" of the schoolmen, is a familiar and domestic creature compared with such "forces." Besides, by the hypothesis, the forces are not matter; and thus all that is of any particular consequence in the world turns out to be not matter on the materialist's own showing. Let it not be supposed that I am casting a doubt upon the propriety of the employment of the terms "atom" and "force," as they stand among the working hypotheses of physical science. As formulæ which can be applied, with perfect precision and great convenience, in the interpretation of Nature, their value is incalculable; but, as real entities, having an objective existence, an indivisible particle which nevertheless occupies space, is surely inconceivable; and with respect to the operation of that atom, where it is not, by the aid of a "force" resident in nothingness, I am as little able to imagine it as I fancy any one else is.

Unless and until anybody will resolve all these doubts and difficulties for me, I think I have a right to hold aloof from materialism. As to spiritualism, it lands me in even greater difficulties when I want to get change for its notes-of-hand in the solid coin of reality. For the assumed substantial entity, spirit, which is supposed to underlie the phenomena of consciousness, as matter underlies those of physical nature, leaves not even a geometrical ghost when these phenomena are abstracted. And, even if we suppose the existence of such an entity apart from qualities—that is to say a bare existence—for mind, how does anybody know that it differs from that other entity, apart from qualities, which is the supposed substratum of matter? Spiritualism is, after all, little better than materialism turned upside down. And if I try to think of the "spirit" which a man, by this hypothesis, carries about under his hat, as something devoid of relation to space, and as something indivisible even in thought, while it is, at the same time, supposed to be in that place and to be possessed of half a dozen different faculties, I confess I get quite lost.

As I have said elsewhere, if I were forced to choose between materialism and idealism, I should elect for the latter; and I certainly would have nothing to do with the effete mythology of spiritualism. But I am not aware that I am under any compulsion to choose either the one or the other. I have always entertained a strong suspicion that the sage who maintained that man is the measure of the universe was sadly in the wrong, and age and experience have not weakened that conviction. In following these lines of speculation I am re-

* See the famous "Collection of Papers," published by Clarke in 1717. Leibnitz says, "'Tis also a supernatural thing that bodies should *attract* one another at a distance without any intermediate means." And Clarke, on behalf of Newton, caps this as follows: "That one body should attract another without any intermediate *means* is, indeed, not a *miracle*, but a contradiction; for, 'tis supposing something to act where it is not."

minded of the quarter-deck walks of my youth. In taking that form of exercise, you may perambulate through all points of the compass with perfect safety, so long as you keep within certain limits: forget those limits, in your ardor, and mere smothering and spluttering, if not worse, await you. I stick by the deck, and throw a life-buoy now and then to the struggling folk who have gone overboard; and all I get for my humanity is the abuse of all whenever they leave off abusing one another.

Tolerably early in life I discovered that one of the unpardonable sins, in the eyes of most people, is for a man to presume to go about unlabeled. The world regards such a person as the police do an unmuzzled dog, not under proper control. I could find no label that would suit me, so, in my desire to range myself and be respectable, I invented one; and, as the chief thing I was sure of was that I did not know a great many things that the —ists and the —ites about me professed to be familiar with, I called myself an agnostic. Surely no denomination could be more modest or more appropriate; and I can not imagine why I should be every now and then haled out of my refuge and declared sometimes to be a materialist, sometimes an atheist, sometimes a positivist; and sometimes, alas and alack, a cowardly or reactionary obscurantist!

I trust that I have, at last, made my case clear, and that, henceforth, I shall be allowed to rest in peace—at least, after a further explanation or two, which Mr. Lilly proves to me may be necessary. It has been seen that my excellent critic has original ideas respecting the meaning of the words "laboratory" and "chemical"; and, as it appears to me, his definition of "materialist" is quite as much peculiar to himself. For, unless I misunderstand him, and I have taken pains not to do so, he puts me down as a materialist (over and above the grounds which I have shown to have no foundation); firstly, because I have said that consciousness is a function of the brain; and, secondly, because I hold by determinism. With respect to the first point, I am not aware that there is any one who doubts that, in the proper physiological sense of the word function, consciousness, in certain forms at any rate, is a cerebral function. In physiology we call function that effect, or series of effects, which results from the activity of an organ. Thus, it is the function of muscle to give rise to motion; and the muscle gives rise to motion when the nerve which supplies it is stimulated. If one of the nerve-bundles in a man's arm is laid bare and a stimulus is applied to certain of the nervous filaments, the result will be production of motion in that arm. If others are stimulated, the result will be the production of the state of consciousness called pain. Now, if I trace these last nerve-filaments, I find them to be ultimately connected with part of the substance of the brain, just as the others turn out to be connected with muscular substance. If the production of motion, in the one case, is properly said to be the function of the

muscular substance, why is the production of a state of consciousness, in the other case, not to be called a function of the cerebral substance? Once upon a time, it is true, it was supposed that a certain "animal spirit" resided in muscle and was the real active agent. But we have done with that wholly superfluous fiction so far as the muscular organs are concerned. Why are we to retain a corresponding fiction for the nervous organs?

If it is replied that no physiologist, however spiritual his leanings, dreams of supposing that simple sensations require a "spirit" for their production, then I must point out that we are all agreed that consciousness is a function of matter, and that particular tenet must be given up as a mark of materialism. Any further argument will turn upon the question, not whether consciousness is a function of the brain, but whether all forms of consciousness are so. Again, I hold it would be quite correct to say that material changes are the causes of psychical phenomena (and, as a consequence, that the organs in which these changes take place have the production of such phenomena for their function), even if the spiritualistic hypothesis had any foundation. For nobody hesitates to say that an event A is the cause of an event Z, even if there are as many intermediate terms, known and unknown, in the chain of causation as there are letters between A and Z. The man who pulls the trigger of a loaded pistol placed close to another's head certainly is the cause of that other's death, though, in strictness, he "causes" nothing but the movement of the finger upon the trigger. And, in like manner, the molecular change which is brought about in a certain portion of the cerebral substance by the stimulation of a remote part of the body would be properly said to be the cause and the consequent feeling, whatever unknown terms were interposed between the physical agent and the actual psychical product. Therefore, unless materialism has the monopoly of the right use of language, I see nothing materialistic in the phraseology which I have employed.

The only remaining justification which Mr. Lilly offers for dubbing me a materialist, *malgré moi*, arises out of a passage which he quotes, in which I say that the progress of science means the extension of the province of what we call matter and force, and the concomitant gradual banishment from all regions of human thought of what we call spirit and spontaneity. I hold that opinion now, if anything, more firmly than I did when I gave utterance to it a score of years ago, for it has been justified by subsequent events. But what that opinion has to do with materialism I fail to discover. In my judgment it is consistent with the most thoroughgoing idealism, and the grounds of that judgment are really very plain and simple.

The growth of science, not merely of physical science, but of all science, means the demonstration of order and natural causation among phenomena which had not previously been brought under those conceptions. Nobody who is acquainted with the progress of scientific

thinking in every department of human knowledge, in the course of the last two centuries, will be disposed to deny that immense provinces have been added to the realm of science; or to doubt, that the next two centuries will be witnesses of a vastly greater annexation. More particularly in the region of the physiology of the nervous system, is it justifiable to conclude from the progress that has been made in analyzing the relations between material and psychical phenomena, that vast further advances will be made; and that, sooner or later, all the so-called spontaneous operations of the mind will have, not only their relations to one another, but their relations to physical phenomena, connected in natural series of causes and effects, strictly defined. In other words, while, at present, we know only the nearer moiety of the chain of causes and effects, by which the phenomena we call material give rise to those which we call mental; hereafter, we shall get to the further end of the series.

In my innocence, I have been in the habit of supposing that this is merely a statement of facts, and that the good Bishop Berkeley, if he were alive, would find such facts fit into his system without the least difficulty. That Mr. Lilly should play into the hands of his foes, by declaring that unmistakable facts make for them, is an exemplification of ways that are dark, quite unintelligible to me. Surely Mr. Lilly does not hold that the disbelief in spontaneity—which term, if it has any meaning at all, means uncaused action—is a mark of the beast materialism? If so, he must be prepared to tackle many of the Cartesians (if not Descartes himself), Spinoza and Leibnitz among the philosophers, Augustine, Thomas Aquinas, Calvin and his followers, among theologians, as materialists—and that surely is a sufficient *reductio ad absurdum* of such a classification.

The truth is, that in his zeal to paint "materialism," in large letters, on everything he dislikes, Mr. Lilly forgets a very important fact, which, however, must be patent to every one who has paid attention to the history of human thought; and that fact is, that every one of the speculative difficulties which beset Kant's three problems, the existence of a Deity, the freedom of the will, and immortality, existed ages before anything that can be called physical science, and would continue to exist if modern physical science were swept away. All that physical science has done has been to make, as it were, visible and tangible some difficulties that formerly were more hard of apprehension. Moreover these difficulties exist just as much on the hypothesis of idealism as on that of materialism.

The student of Nature who starts from the axiom of the universality of the law of causation can not refuse to admit an eternal existence; if he admits the conservation of energy, he can not deny the possibility of an eternal energy; if he admits the existence of immaterial phenomena in the form of consciousness, he must admit the possibility, at any rate, of an eternal series of such phenomena; and, if

his studies have not been barren of the best fruit of the investigation of Nature, he will have enough sense to see that when Spinoza says "Per Deum intelligo ens absolute infinitum, hoc est substantiam constantem infinitis attributis," the God so conceived is one that only a very great fool would deny, even in his heart. Physical science is as little atheistic as it is materialistic.

So with respect to immortality. As physical science states this problem, it seems to stand thus: Is there any means of knowing whether the series of states of consciousness, which has been causally associated for threescore years and ten with the arrangement and movements of innumerable millions of successively different material molecules, can be continued, in like association, with some substance which has not the properties of "matter and force"? As Kant said, on a like occasion, if anybody can answer that question, he is just the man I want to see. If he says that consciousness can not exist except in relation of cause and effect with certain organic molecules, I must ask how he knows that; and if he says it can, I must put the same question. And I am afraid that, like jesting Pilate, I shall not think it worth while (having but little time before me) to wait for an answer.

Lastly, with respect to the old riddle of the freedom of the will. In the only sense in which the word freedom is intelligible to me—that is to say, the absence of any restraint upon doing what one likes within certain limits—physical science certainly gives no more ground for doubting it than the common sense of mankind does. And if physical science, in strengthening our belief in the universality of causation and abolishing chance as an absurdity, leads to the conclusions of determinism, it does no more than follow the track of consistent and logical thinkers in philosophy and in theology before it existed or was thought of. Whoever accepts the universality of the law of causation as a dogma of philosophy, denies the existence of uncaused phenomena. And the essence of that which is improperly called the free-will doctrine is that occasionally, at any rate, human volition is self-caused, that is to say, not caused at all; for to cause one's self one must have anteceded one's self—which is, to say the least of it, difficult to imagine.

Whoever accepts the existence of an omniscient Deity as a dogma of theology, affirms that the order of things is fixed from eternity to eternity; for the foreknowledge of an occurrence means that the occurrence will certainly happen; and the certainty of an event happening is what is meant by its being fixed or fated.*

* I may cite in support of this obvious conclusion of sound reasoning, two authorities who will certainly not be regarded lightly by Mr. Lilly. These are Augustine and Thomas Aquinas. The former declares that "Fate" is only an ill-chosen name for Providence.

"Prorsus divina providentia regna constituuntur humana. Quæ si propterea quisquam fato tribuit, quia ipsam Dei voluntatem vel potestatem fati nomine appellat, *sententiam teneat, linguam corrigat.*"—Augustinus *De Civitate Dei*, V, c. i.

The other great doctor of the Catholic Church, "Divus Thomas," as Suarez calls him, whose marvelous grasp and subtilty of intellect seem to me to be almost without a paral-

Whoever asserts the existence of an omnipotent Deity, and that he made and sustains all things, and is the *causa causarum*, can not, without a contradiction in terms, assert that there is any cause independent of him; and it is a mere subterfuge to assert that the cause of all things can "permit" one of these things to be an independent cause.

Whoever asserts the combination of omniscience and omnipotence as attributes of the Deity, does implicitly assert predestination. For he who knowingly makes a thing and places it in circumstances the operation of which on that thing he is perfectly acquainted with, does predestine that thing to whatever fate may befall it.

Thus, to come, at last, to the really important part of all this discussion, if the belief in a God is essential to morality, physical science offers no obstacle thereto; if the belief in immortality is essential to morality, physical science has no more to say against the probability of that doctrine than the most ordinary experience has, and it effectually closes the mouths of those who pretend to refute it by objections deduced from merely physical data. Finally, if the belief in the uncausedness of volition is essential to morality, the student of physical science has no more to say against that absurdity than the logical philosopher or theologian. Physical science, I repeat, did not invent determinism, and the deterministic doctrine would stand on just as firm a foundation as it does if there were no physical science. Let any one who doubts this read Jonathan Edwards, whose demonstrations are derived wholly from philosophy and theology.

Thus, when Mr. Lilly, like another Solomon Eagle, goes about proclaiming "Woe to this wicked city!" and denouncing physical science as the evil genius of modern days—mother of materialism, and fatalism, and all sorts of other condemnable isms—I venture to beg him to lay the blame on the right shoulders; or, at least, to put in the dock, along with Science, those sinful sisters of hers, Philosophy and Theology, who, being so much older, should have known better than the poor Cinderella of the schools and universities over which they have so long dominated. No doubt modern society is diseased enough; but then it does not differ from older civilizations in that respect.

lel, puts the whole case into a nutshell, when he says that the ground for doing a thing in the mind of the doer is as it were the pre-existence of the thing done:

"Ratio autem alicujus fiendi in mente actoris existens est quædam præ-existentia rei fiendæ in eo" (*Summa*, Qu. xxiii, Art. i).

If this is not enough, I may further ask what "Materialist" has ever given a better statement of the case for determinism, on theistic grounds, than is to be found in the following passage of the *Summa*, Qu. xiv, Art. xiii:

"Omnia quæ sunt in tempore, sunt Deo ab æterno præsentia, non solum ea ex ratione quâ habet rationes rerum apud se presentes, ut quædam dicunt, sed quia ejus intuitus fertur ab æterno supra omnia, prout sunt in sua præsentialitate. *Unde manifestum est quod contingentia infallibiliter a Deo cognoscuntur*, in quantum subduntur divino conspectui secundum suam præsentialitatem; et tamen sunt futura contingentia, suis causis proximis comparata."

Societies of men are fermenting masses, and as beer has what the Germans call "Oberhefe" and "Unterhefe," so every society that has existed has had its scum at the top and its dregs at the bottom; and I doubt if any of the "ages of faith" had less scum or less dregs, or even showed a proportionally greater quantity of sound wholesome stuff in the vat. I think it would puzzle Mr. Lilly or any one else to adduce convincing evidence that, at any period of the world's history, there was a more wide-spread sense of social duty, or a greater sense of justice, or of the obligation of mutual help, than in this England of ours. Ah! but, says Mr. Lilly, these are all products of our Christian inheritance; when Christian dogmas vanish, virtue will disappear too, and the ancestral ape and tiger will have full play. But there are a good many people who think it obvious that Christianity also inherited a good deal from paganism and from Judaism, and that if the Stoics and the Jews revoked their bequest the moral property of Christianity would realize very little. And, if morality has survived the stripping off of several sets of clothes which have been found to fit badly, why should it not be able to get on very well in the light and handy garments which Science is ready to provide?

But this by-the-way. If the diseases of society consist in the weakness of its faith in the existence of the God of the theologians, in a future state, and in uncaused volitions, the indication, as the doctors say, is to suppress theology and philosophy, whose bickerings about things of which they know nothing have been the prime cause and continual sustenance of that evil skepticism which is the Nemesis of meddling with the unknowable.

Cinderella is modestly conscious of her ignorance of these high matters. She lights the fire, sweeps the house, and provides the dinner, and is rewarded by being told that she is a base creature devoted to low and material interests; but in her garret she has fairy visions out of the ken of the pair of shrews who are quarreling down-stairs. She sees the order which pervades the seeming disorder of the world; the great drama of evolution with its full share of pity and terror, but also with abundant goodness and beauty, unrolls itself before her eyes; and she learns in her heart of hearts the lesson, that the foundation of morality is to have done, once and for all, with lying; to give up pretending to believe that for which there is no evidence, and repeating unintelligible propositions about things beyond the possibilities of knowledge.

She knows that the safety of morality lies neither in the adoption of this or that philosophical speculation, or this or that theological creed, but in a real and living belief in that fixed order of Nature which sends social disorganization upon the track of immorality as surely as it sends physical disease after physical trespasses; and of that firm and lively faith it is her high mission to be the priestess.—*Fortnightly Review.*

SOME POINTS ON THE LAND QUESTION.

By OLIVER B. BUNCE.

IN a recent number of a religious periodical there occurred the following sentence: "There can be no question as to the abstract proposition that land is not a proper subject for private ownership; that labor alone creates wealth, and labor does not create land."

It is obvious from the appearance of a statement like this in a publication of high standing that many worthy people are half ready to accept Mr. Henry George's theory of a common ownership in land. They are not ready, perhaps, to sanction his scheme of ruthless confiscation, but they are saying to themselves that at bottom his theory is right, and they are wondering whether land can not ultimately be restored to the community, to which, it is said, it rightfully belongs. My purpose, therefore, in reply to the proposition so confidently affirmed by the writer I have quoted, is to make good the following points:

1. That land, no less than other things, is a proper subject for private ownership.

2. That labor alone does not create wealth.

3. That labor creates the conditions that make land wealth just as much as it creates the conditions that make other things wealth.

And, in continuance of the subject, I hope to show—

4. That the greater part of the land is now practically held by the community, for it enjoys in common all that the land produces.

5. That the confiscation of the rental value of land by means of taxation would in the main be a confiscation of the proceeds of labor.

6. That unearned increment in land, of which so much is said, is not more hurtful to the community than other forms of unearned increment.

7. That the accomplishment of Mr. George's purpose would be destructive to the best interests of the community.

It will be said that this is attempting a great deal in the space of one short magazine article, but let us see what can be done.

Now, it is true that labor does not create land, for land primarily comes from the hand of Nature, but then it is equally true that labor does not create gold, or silver, or coal, or timber, or grain, or wool, or any other of the primary gifts of Nature, commonly accounted in the market as wealth. Labor discovers, transports, cultivates, fashions, blends, makes useful in some way the free gifts of Nature, and they become wealth; labor also clears the land, drains it, fences it, fertilizes it, plants it, builds roads and bridges that make it accessible, and it becomes wealth. We find, therefore, at the very beginning of our quest, that land stands just where other kinds of property stand, and be-

comes wealth by certain processes similar to those by which movable substances become wealth.

But labor alone does not create wealth. Three things are necessary for the production or creation of material wealth: first, a natural product; second, the labor that fashions or utilizes it; third, *demand.** Unless there is demand, unless the product that labor has brought into the market meets some want or gratifies some desire, the labor has gone for nothing. Hence it is not true that labor alone creates wealth. Nor does labor determine the measure of wealth. Whether I shall be well paid or ill paid for my labor depends upon its estimation in the market. I may labor many months in producing an article that can not be exchanged—that is, that does not sell; another man may labor no longer on something else that comes immediately into such demand that the maker thereof is enriched by it. Labor is always an indispensable factor in the production of wealth, but it is clear that it is not the sole factor.

That land is not wealth as it comes from the hands of Nature, but becomes wealth by human connection with it, is evident from the fact that wild land, when remote from civilized centers, has no price whatever. You can purchase in many parts of the world land enough for a kingdom at the price of a song; you can in some places appropriate a kingdom, if a wilderness makes a kingdom, by simply calling it your own. You can purchase land in Mexico for ten cents an acre, and it would not command even this almost nominal price were it not wanted for cattle-rearing. When we buy or sell land, the price paid is not for a mere stretch of earth, but either for improvements or conditions, for something given to the land by the efforts of man, or for something that has been developed in connection with the land as a consequence of man's relation to it. *Conditions* make the wealth that pertains to land, and it is always *conditions* that we buy and sell. And we do not always pay for or obtain the price in labor and capital that the conditions absolutely cost. Many pieces of cultivated land, not near the great towns, can be purchased at a price that is probably less than it cost to clear them, fence them, drain them, break up the sod, plant orchards upon them, and construct roads that lead to them. We talk about buying land just as we talk about buying coal, lumber, fish, minerals, grain, etc., when in all cases we buy labor, conditions, or rights, the land or the substances themselves being free from the hand of Nature. What is the price of coal in the mine, of lumber in the distant forest, of fish in the sea, of metals buried a thousand feet deep in the hills, of the phosphorus and other elements that combine to make us wheat and corn? Nothing. Coal in a mine situated for working or transportation a little more favorably than coal in other

* There are a few kinds of wealth that do not proceed from a natural product, such as patent-rights, copyrights, and productions in art. Macleod makes demand or exchangeability the sole test of wealth.

mines is worth a few cents a ton, perhaps ;* but coal in mines inaccessible by roads, in its absolute natural state, has no price whatsoever. When we buy fish we merely pay the fisherman for his labor. It is cheaper for us to do this than to go ourselves and catch the fish. When we require grain, or lumber, or wool, or cotton, we simply employ some one to do the work necessary for the production of grain, wool, or cotton, or for transporting the lumber to our door. Land, coal, the metals, etc., are therefore all alike—they are wealth by virtue of certain conditions ; they are not wealth in their natural state.

A community of ownership in land is demanded, and yet under our present social arrangement every man has his share of all that land produces. Land is occupied by one class of producers, but these producers do not enjoy its bounties one whit more than other classes do.† Practically, the land—confining ourselves for the present to agricultural land—is now as much the property of the community as it was when private ownership was unknown. With primitive peoples the possession of land is indispensable for existence. There are but two industries, the feeding of herds and the planting of corn, and the man or the tribe without land must needs perish. Civilization has brought about a very different state of things. The development of agriculture and the multiplication of industries have released a large body of workers from the soil. But the latter are by no means thereby cut off from the benefits of the land, for the products of their labor in other directions exchange freely for the products of the land, and secure for their enjoyment as much of these products as if they themselves had delved for the ore, planted the corn, or tended the herds. The world is not poorer, but richer, as a consequence of this separation of some part of human industry from the soil. If I am in possession of land I must labor on the land if I would enjoy its yield ; and if it is not in my possession I have still the privilege of enjoying its yield by paying some one else to perform the labor. As matters stand, I would rather pay Farmer Black for a bushel of potatoes than purchase and cultivate a garden in order to raise my own potatoes.

* I recall an instance of an owner of a coal-mine being paid for the privilege of working it six cents a ton for all that was mined.

† "Are there not bonanza mines, fortunes in petroleum, monopolies of metals and minerals?" will be asked. No rule can be made that does not have its temporary exceptions. Taking the silver and gold mines of the world during long periods, we will find that they have not paid their workers more than the average of profits that other forms of labor yield. If a man has a monopoly of any special product, he is enabled to tax his fellow-men to his own great advantage; but the gratuities of Nature are so distributed over the world that monopolies are exceptional, and very rarely maintained beyond short periods. I generalize from common conditions, from the usual and ordinary operations of production. The demand for whale-oil may temporarily be so much more than the supply that those who hold the oil are enabled to command excessive profits; but we can not argue from this that the whales in the sea are not common property—are not absolutely gratuities of Nature, conditions only determining the price of their product in the market.

If the truth were fairly told, I am afraid that the farmer who owns the land gets less for his labor in raising his potatoes than I, who own no land, get for my labor in obtaining the means whereby I am enabled to purchase the potatoes.*

In truth, we each of us obtain by the present social co-operative system a vast deal more of the bounties of Nature than we possibly could if in possession of land with nothing but our individual efforts to rely upon ; and if we look the world over, we shall find that those communities enjoy the greatest abundance in which there is a great diversity of industry, an unrestricted accumulation of wealth, and where private ownership has been guaranteed by the authority of the state and supported by the consent of the people.

But private ownership of land is a monopoly, say Mr. George and his followers. Land belongs to the whole community ; the state, therefore, should be the common landlord ; and the first great step in a general act of readjustment is to appropriate the rental value of land by taxation. Improvements, it is magnanimously conceded, are not to be taxed ; but land only to the full extent of its rental value. But what is the rental value of agricultural land apart from its improvements ? According to Ricardo, all that land produces above the lowest point of production that will support the laborer goes, by virtue of the competition that always exists, to the landlord as rent. In this country freeholds are so general that we have little practical exemplification of the operation of the laws of rent ; but, should the state become the common landlord, these laws would be sure to manifest themselves. According to this theory, if land yielding ten bushels to the acre is sufficient to subsist the worker thereon, then all land that yields more than ten bushels to the acre has a rental value equal to this excess. That is to say, the Georgeian plan of taxation, in so far as it affected agricultural lands, would, on all the farms of the country, absolutely *confiscate the entire results of labor above the mere point of subsistence.*

Ricardo's theory of rent may not be mathematically true, but it is unquestionably approximately true, because in the briskness of competition, in the struggle for subsistence, land must, if sought for at all, command a rental value proportionate to its yield above a certain minimum point. Mr. George will say that this is not what he means.

* The following statement, in a recent article by Edward Atkinson, illustrates how completely the product of the land falls to the benefit of the whole community: "One man working the equivalent of three hundred days in the year, or three men working one hundred days in the harvest-season on the far plains of Dakota in the production of wheat, aided by one man working three hundred days in milling and barreling the flour, and supplemented by two men working three hundred days in moving wheat and flour from Dakota to New York, and in keeping all the mechanism of the farm, the mill, and the railroad in good repair—four men's work for one year places one thousand barrels of flour at the mouth of the baker's oven in the city of New York—a yearly ration of bread for one thousand men and women."

It is no doubt true that he did not anticipate any such result, but is it not a logical consequence of a plan for seizing upon the rental value of land?

"But," say our land theorists, "land in favorable situations, and specially in or near great cities, brings enormous prices, not because of labor given to the land or of improvements built upon it, but for the reason that its situation makes it in demand and competition brings up the price. This land increased in value because of enterprises initiated often by persons not owners of the land, being an increase of value not due to the owner of the land, not because of anything he has planned or brought about, not as the result of his labor, skill, sagacity, or enterprise, but because of other people's labor, skill, and enterprise, and which becomes a tax that the community, as a whole, pays to the owner of the ground. Assuredly this is unjust. Why should men be allowed to grow enormously rich by lying still and simply retaining possession of their land?"

This is all true. I have spoken of value being due to labor or *conditions*, and here we have value that arises from demand, which is one form of conditions, just as the value of innumerable other things arises from demand. At first sight the position of the land theorists appears here to be very plausible; but there is nothing new in it. John Stuart Mill dwelt on the apparent injustice of what he calls unearned increment; but Mill saw that the appropriation by the state of this increment could not be accomplished without greatly disturbing the whole structure of society. He never even proposed a plan for the appropriation of this increase in the future, let alone of violently seizing upon a form of wealth that had grown up under the sanction of the laws.

But, after all, what is the difference between unearned increment in land and unearned increment in other kinds of property? All natural products are the bounty of Nature just as land is, and, like land, often yield to their possessors an unearned profit. Shall the Government compel all holders of wool, sugar, grain, iron, cotton, fish, lumber, and other products, to surrender through the machinery of a tax all profits that come from an increased demand for these articles? Unearned increment in products being often the result of conspiracies and schemes to the detriment of the public, its confiscation would be much more just than the confiscation of the increased value of land. The owner of land can not by his own personal efforts increase its value except by acts of advantage to the community—by building railroads, by erecting desirable buildings, by fostering industries; whereas the owner of products can not by his own personal efforts increase their value except by producing a "corner," by making them scarce, and thereby imposing a tax on consumers. Our theorists are really at war with a comparatively innocent form of unearned increment, but shut their eyes to a guilty form of it.

Unearned increment is commonly a direct tax upon society and un-

deniably is often an evil; but it is unavoidable so long as individual liberty and freedom of exchange exist, and can not be appropriated or even legislated upon without more evil arising than would be prevented. And then would not such an interference on the part of the state be an instance of a rule that should work both ways? If it is right for the Government to confiscate my profits on lands or goods when I am so fortunate as to make profits, it ought to make good my losses when my plans miscarry. If wheat or corn go up on my hands, and the tax-collector seizes upon the increase, shall I not be entitled to a bounty when corn and wheat on my hands go down? The new railroad has doubled the value of my lots in one town, but in another a diversion of trade and transportation in consequence thereof has nearly paralyzed everything, and my lots there are almost valueless. The state shall cheerfully have all the gain in one instance if it will make good the decline in the other. If unearned increment is proclaimed on one side of the reform banner, it should exhibit undeserved loss on the other.

But, assuming that there is some justice in the plan for appropriating unearned increase in the value of land, what would be the consequences if it were carried out? Mr. George does not propose compensation to owners for this arbitrary seizure of their wealth. Their property has been procured, under the sanction of the laws, by the general consent of the community and in reliance upon established usage, and hence its appropriation or confiscation under any plan would not only be grossly unjust, but it would destroy all sense of security in any kind of property, and fairly bring chaos itself upon us. Such a measure would be like a cyclone of the most destructive character through the length and breadth of the land. It would force into litigation every savings-bank, trust company, and life-insurance company in the country; it would cut off the revenue of innumerable institutions of learning and charity; it would rob millions of persons of their savings, impoverishing old age, young children, and dependent women; it would bring bankruptcy upon tens of thousands of traders, and impair credit everywhere. No class would suffer more than the poor, who hold in their savings through the savings-banks, liens amounting to thousands of millions upon landed property, much of which would be irretrievably lost.

And when all had been done, what would have been accomplished? Time would repair the damages and heal the wounds thus inflicted; but what compensation would there be? Mr. George declares that the nationalization of land would bring great blessings to struggling millions, but he does not anywhere show us how, or by what means. In his necromancy, private ownership of land and great poverty are here; community of land and general prosperity there; but we have not a word of explanation by what means a change of many landlords for one landlord is to bring about the splendid result he depicts. Taxa-

tion would fall on land, instead of, as now, on various forms of property, and this would be all. Doubtless, this would confer some benefit, but how is it to secure a juster distribution of profits, how is it to cause poverty to change its coat, and plenty come where want has hitherto existed? It is impossible to see how these results are to ensue, and the land theorists do not tell us.

The good that is pictured is a dream, whereas the evil would be immeasurable; and when we had all finally settled down to the new conditions, we should contemplate some such picture as the following: All the farm-lands in the country in a condition of shameful neglect, and their productiveness seriously decreased; state tenants going from farm to farm, cultivating the fields solely for their immediate yield, neither planting orchards, nor fertilizing, nor keeping in repair fences or drains. The ambition to improve would be paralyzed, and the desire to keep up the productiveness of the acres to a standard would no longer exist. As soon as one piece of land would be exhausted, the tenant would move to another. Every motive for careful cultivation and preservation would be replaced by motives for immediate profit. These conditions would follow any form of national ownership; but if George's tax of rental value were strictly enforced, there would be no inducement, as I have shown elsewhere in this article, to work the land at all. In towns and cities, or wherever land is used for commercial purposes, we should see rent paid just as it is now, but to the state instead of to individuals. The only difference would be, that all taxes would fall on land. Houses, bonds, mortgages, stocks, personal effects would be untaxed; that is to say, the greater part of most rich men's possessions would be unburdened, but rent would remain just as it is now, and enter into the price of commodities just as it does now. As the scheme is to tax up to the rental value, this rental value would be what competition and demand made it. Favorable situations would be bid for and go to the highest bidder, and consequently the poor would be pressed to the wall as much then as now.

Nor is this all. Under such an enormous enlargement of the powers of Government, jobbery and corruption would have a field for its operation such as the most sanguine Tweed never dreamed of. Our politicians would have all the corner lots, all the choice situations. And then, if the rents should prove to be in magnitude what Mr. George supposes, think of the funds that would lie in the state treasuries as tempting reserves for the schemes and devices of speculators and law-makers!

I have been able in the brief space allowed me to no more than roughly hint at all the possibilities involved in the startling scheme of the Georgeian economics. If it were possible to collect unearned increment, or to determine what it is and so adjust taxation that it should take just the increment and no more (which would be about as difficult as for Shylock to cut his pound of flesh and shed no blood), the gain

thereby would be nothing to the tremendous injury to the whole people that would ensue? Can we increase the prosperity and well-being of a community by putting a penalty on success? Can a people advance under laws that check enterprise, that put a fine on sagacity, that repress energy, that destroy the liberty of the individual? There are possibly some evils that arise from private ownership of land, but the blessings that arise from it are simply incalculable. It is absurd to call it a monopoly; it is that only in name, in this country at least, where the land is really held by the people, and is always attainable by the people. We are peculiarly a landed democracy. Our farmers, for the most part, cultivate their own acres, and on every hill-side in the country stand innumerable cottages owned by their occupants and earned by labor and self-denial. The ownership of land is one of the greatest stimulants to right-doing that exists: it excites ambition; it promotes industry; it induces thrift and abstemious habits; it is the hope of youth and the pride of age. It is the very essence of wisdom to encourage it. Anarchy is impossible among a people wedded to the land. What if a few persons in the great cities become rich by the increase of the value of land—what is this to the welfare of the millions that have secured small footholds on the earth, and built their roof-trees? "I tell you what," says a French author, "those old fellows that invented marriage knew what they were about." So also, we may say, did those old fellows that invented private ownership of land.

FETICHISM OR ANTHROPOMORPHISM.

By GEORGE PELLEW.

IN the recent controversy between Mr. Spencer and Mr. Harrison on the subject of the relation between science and religion, the question of the historical priority of fetichism over spiritism or anthropomorphism was discussed at some length, and was somewhat dogmatically determined in the negative, by Mr. Spencer. Mr. Spencer, in his last contribution to the general controversy, cited a large number of authorities to support the position that all instances of fetichism are to be explained as the results of animism, namely, that a stone or a tree never has become an object of religious worship except as associated in some way with the notion of a ghost or a dream-spirit. The discussion was closed with this statement, and has not since been reopened. It may be, however, of interest to suggest some considerations which tend to show that Mr. Spencer's conclusion on this point was perhaps hasty and subject to revision, and that Mr. Harrison was possibly correct in asserting that the attitude of primitive men toward the universe must be supposed to have been fetichistic rather than anthropomorphic.

In attempting to ascertain the probable nature of primitive religion,

no direct evidence, of course, is attainable. Man is now supposed to have existed upon the earth for perhaps more than fifty thousand years, and the earliest or most rudimentary beliefs known to have existed in historical times can be regarded only as survivals of thought in no respect necessarily primitive.

Arguments from the probable course of evolution, and various indirect arguments from analogy and from the application of ordinary common sense, furnish all the light that is possible on this question.

The simplest and most permanent element of religion in general is admitted to be a vague sense of wonder and awe in the presence of the external universe. Emotions of wonder and awe depend upon a consciousness of something mysterious or unexplained, and a consciousness of the lack of explanation can not arise until some perception has been gained of the relation of cause and effect.

The processes of evolution have been continuous, according to Mr. Spencer and modern men of science, from the inanimate world to man, or, at any rate, from the first speck of protoplasm that appeared on the earth's surface. With the first emergence of conscious perception on the earth of cause and effect, that is, practically, with the rise of reason as distinguished from instinct, must be placed the first beginning of the qualities or habits of thought or feeling that in time became religion. In an interesting essay on "Fetichism in Animals," Mr. Romanes has collected several instances of a sense of the mysterious, accompanied by wonder and awe or alarm in the higher animals. Of a like nature is the terror of a horse at the first sight of a steam-engine, of a dog at a person who makes unaccountable grimaces at it, and of most animals at the sound of thunder.

The sense of the mysterious, combined with instinctive or even conscious wonder and terror at unaccountable phenomena, can not, however, in itself be said to constitute religion. It is an element, but only one element, of religion. Even a sense of entire dependence upon external or higher powers would not, as Canon Liddon well said, be sufficient. "What is this power? That is a question which must be answered before feeling can determine its complexion."* The power to ask, much more the power to devise some answer to such a question as this, belongs clearly to a much later stage of evolution than does the simple perception of cause and effect that gives rise, as has been seen, to a sense of the mysterious. Phenomena must have been vaguely felt and contemplated, and from time to time wondered at, long before curiosity would be excited as to their nature; primitive savages would for ages observe natural movements without much intellectual curiosity, simply observing that the sun and moon moved, and animals and other things moved, without asking why they moved, but merely noticing and recording the fact of their motion.

The sense of the mysterious, which is one chief element of religion,

* H. P. Liddon, "Some Elements of Religion," London, 1873, p. 11.

would be excited clearly at first, not by the general order of Nature, not by familiar sights and sounds, but by unusual events, more especially by events occurring suddenly and attended or followed by danger or disaster; and it would not be until a spirit of curiosity was active that such events would be attempted to be explained. Curiosity is of late appearance in the course of mental evolution in animals, as Mr. Romanes has pointed out in his book on that subject: it is most marked in the family of apes, and must have been a principal factor in determining the development of human attributes in certain branches of that or a kindred family of primates. The natural operation of curiosity in those half-animal beings, when directed toward especially unaccountable cosmical events, would determine the nature of primitive religion. In what manner such curiosity would be satisfied can be approximately ascertained only by considering the mental operations that at that time had been evolved.

At the time in question, prior to the existence of definite language, reasoning could be little more than half-conscious, half-unconscious inferences from one set of objective phenomena to another, reasoning by analogy, of the crudest, baldest, most unscientific and unphilosophic form. This process of reasoning has its purely physical counterpart in the simplest reflex actions of the least developed organisms, that react in a similar manner to similar impressions. A Venus's fly-trap will clasp and inclose a little stone as well as a fly, although the fly only is digestible; and it is only by the gradual evolution of more and more delicate organs of sense and of nerves and nerve-centers of corresponding delicacy and complexity, that things apparently, but not really, alike come to be discriminated. The senses do not deceive, but it is the reasoning powers that fail, when a fish rises to a worsted fly, or a bird pecks at a painted cherry, or a little puppy barks and snaps at a rolling ball; and the method of reasoning, instinctive or conscious, is in each case the same, from similarity of appearance to similarity of cause. The basis of all reasoning is essentially the same, depending on the involuntary association of ideas, by which is simply meant the tendency when two ideas have once been associated in the mind for the first idea on its subsequent recurrence to recall the second idea, and *vice versa*. Similar habits of thought must have been normal among primitive men, largely instinctive, and unmodified by reflection. To the earliest men the movements of other men would seem to require no philosophical explanation, as to a dog the movements of another dog presumably seem to require none, except so far as their actions might seem indicative of hostility or assistance. To such men the movements of animals would be regarded as not different in kind from the actions of their fellow-men, and until they had learned better by experience or experiment they would tend to regard animals as not widely different from men, proper to coax or to blame, or if very strong and ferocious, to supplicate. In a similar way all moving things might

naturally seem alive, agencies alike for good or evil, with powers mysterious indeed but not wholly dissimilar. Even inorganic things, stones and sticks, whatever may ever have been observed to move without apparent cause, might be supposed to be able to move, as animals might naturally be supposed to be able to talk. As the primitive man would urge on his half-tamed wolf or jackal to seize the deer or wild beast he was hunting, he would tend to caress or urge on the spear he threw or the bow he aimed; for, before subjective knowledge or abstract thought was possible, as soon as a thing moved, although the man pushed it, bent or threw it, it would become a moving thing, and seem to him to act as a living thing. The notion of a cause of motion, wholly independent of the moving thing, could not arise without greater power of abstract thinking than can be attributed to primitive men.

So soon as intelligent curiosity began to mingle with the dull wonder with which human beings had long regarded unusual natural events—such as, for instance, an eclipse, a flash of lightning, or a flood—the only explanations that could suggest themselves would be the logical result of the prevalent habits of thought, of such simple analogical reasoning as has been referred to. All moving things being vaguely felt to be living, the sun in eclipse would be thought of as sick or wounded; the lightning as a creature like a rattlesnake that makes a noise, glides swiftly, and strikes suddenly; the flood as the river itself in a rage or passion. Such vague explanations as these of the nature of the external universe, or of special events in it—explanations so little self-conscious and so little reasoned as hardly to deserve the name of "explanations"—would seem to be in the natural course of evolution the first notions that could be called religious; but such notions are pure fetichism. The characteristic of such a state of thought is, that the moving principle is not thought of as separate from the moving thing, nor the living principle as separate from the living being, nor the spirit of other men or animals as separate from their bodies. The observances appropriate to such a religion would consist in appeals to those external beings or imprecations upon them, similar to those appropriate between man and man, because those beings would be regarded as living and so not felt to be wholly different from men; but in every case the thing or object itself, and not anything unseen, would be the object of any ceremonial observance.

A community of children between the ages of two and five might naturally evolve a somewhat similar religious system. The baby who cries out, "Naughty door!" when it pinches its fingers in the hinges; the child who urges a spinning-top to continue spinning, or is angry with it for stopping; or who listens with wondering awe to a watch and asks if it is alive, long before any of them have any notion of spirit or ghost, or of unseen causes of action—all illustrate how naturally fetichism results from simple modes of thinking and reasoning. Similar habits of

thought account for much of both ancient and modern mythology, without the intervention of spiritism; they appear as a revival in civilized nations in the astrology and alchemy of the middle ages, and may to-day be traced among many savage tribes. The Zuñis, for instance, observe that the rattlesnake makes a rattling noise, moves with rapid zigzag motion across the grass, strikes and kills suddenly. They notice that the lightning is succeeded by rattling thunder, that it moves with rapid zigzag motion across the sky, strikes and kills suddenly; they therefore call the lightning the brother of the rattlesnake, and they refrain from killing a rattlesnake for fear the lightning may strike them! It is plain that such a notion could have arisen without any conception of a spirit of the lightning distinct from the lightning, of a ghost or snakeship distinct from the snake. Similarly, the Zuñis speak of the rainbow as akin to the measuring-worm, because it appears after rain, and has a striped, arched back, and so forth. It is plain that such a notion could have also arisen without any conception of a rainbow-spirit or of a worm-spirit. If fetichism could have arisen without any connection with spiritism, it must scientifically be held to have so arisen, unless spiritism could have resulted from as early or from an earlier stage of thought.

While fetichism, however, could and naturally would result from purely analogical reasoning from one object to another, anthropomorphism or animism could possibly result only from reasoning of a much less simple character. It is essentially subjective, and involves considerable power of abstract thinking. It is subjective; since, before a savage could imagine unseen personalities as the cause of visible movement, he must have a notion of his own personality, distinct from his body, as the cause of his own movements. The notion of personality is an abstract idea that is peculiarly complex, and that is but slowly developed in conscious beings. Even a modern baby is supposed to attain the notion of "self" and the meaning of "I" and "me" but slowly, as is aptly described by the poet in "In Memoriam." It is clear that a general notion or abstract idea may be formed from objective perceptions much more easily than the simplest abstract idea that can result only from self-conscious reflection, and no number of purely objective perceptions could ever suggest the notion of "will," "cause," or "spirit," for there are no simple states of consciousness excited by sensation corresponding to such notions. It is unscientific, therefore, to assume that the earliest biped that could be called human rather than anthropoid possessed an innate intuition of personality, and if he had no such intuition, his crude notions about the nature of the universe could not have been anthropomorphic or animistic.

The simplest power of abstract thinking is, even by Mr. Romanes, denied to animals. It is generally admitted to be impossible without language, and language not in its simplest, most elementary form. It is unscientific, therefore, to ascribe such a power to primitive men in

whom articulate speech was but just beginning to emerge from inarticulate noises and gestures. Even if, then, it were admitted, as Chauncey Wright suggested, that the notion of "will" and "personality" arose primarily from the objective observation of other men, since those ideas involve abstraction, it is yet unscientific to assert that the attitude of primitive men toward the universe was in any sense anthropomorphic.

Dream-spirits and ghosts may, indeed, have been the earliest *theory* to account, in a semi-scientific way, for cosmical movements and events; but, from an historical point of view, it would seem that phenomena must have been wondered at, and half-unconsciously classified, long before there was any attempt at any even partly coherent explanation of them. To prehistoric men the world must have seemed for ages, if the theory of evolution is accepted, as a mysterious jumble of half-living creatures, until it became partly intelligible as the theatre of the operation of a multitude of spirits. During those remote ages these strange creatures would themselves be the only possible objects of worship—and such worship would be properly termed fetichism—it could most certainly not be termed anthropomorphism or spiritism. Spiritism, when, with increasing intelligence and reasoning powers, it first began to be suggested, would have seemed almost like the revelation of a new religion, or like the discovery of a new scientific truth; older forms and notions would be retained, but with new meanings and new explanations, and the original meanings and explanations would be soon forgotten; but the beginnings of religion, unless the principle of continuity is discarded, must be sought for in the incoherent and fetichistic fancies that animism supplanted. There is some reason for believing that in recent times some such change from a simple analogical fetichism to animism has taken place among the Zuñis. It is asserted, for instance, that until lately they conceived of a bow as akin to a beast of prey, but that now they speak of it as inhabited or directed by the spirit of a deceased warrior.

The argument may now be summed up briefly as follows: Fetichism would naturally result from the simple objective observation and elementary analogical methods of reasoning that must have been characteristic of primitive men. Anthropomorphism involves a power of subjective introspection and of abstract thinking that can not have been possessed by primitive men. Between the earliest anthropomorphic conceptions of the universe of which we have record, and the simplest possible attitude toward the universe that could be described as in a rudimentary form religious, there must have been a long period of evolution—a period that may well have been measured by thousands of years—during which there may have been an indefinite number of gradations of religious sentiment and theory. During that period, then, there must have been some stages of thought, as an essential condition in the evolution of anthropomorphism, from the mild-eyed, incurious

wonder of anthropoid apes or troglodytes that could be called by no other name than fetichism.

It may, at least, be said in conclusion, that the absence of extant evidence of such a stage of thought no more proves that it never existed than the absence of the bones of the missing link proves that men are not descended from non-human ancestors. All the negative evidence, then, that Mr. Spencer has so laboriously collected for the annihilation of Mr. Frederic Harrison, has no conclusive bearing on this question.

NOTE.—The conclusions of this article are confirmed by a variety of arguments and instances collected by Dr. Fritz Schultze, in "Fetichism: a Contribution to Anthropology and the History of Religion." Chapter III, on "The Relation between the Savage Mind and its Object," is of special value in this connection.

It may be further noticed that the evidences of fetichistic habits of thought among children are daily accumulating. In "Mind," vol. xli, page 150, for instance, Mr. E. M. Stevens relates the following anecdote of his son:

"He personifies the sun in an amusing way. One day, when he was about two years and two months old, he was sitting on the floor in a great temper over some trifle. He looked up and saw the sun through the window. He suddenly stopped crying, and said angrily, 'Sun *not* look at Hennie!' He said this two or three times, and then, finding the sun persistently looked at him, he changed his tone to one pathetically imploring, and said, '*Please*, Sun, not look at poor Hennie!" I have noticed this adjuration of the sun, when he has been crying, two or three times since." Is it to be supposed that this little two-year-old boy believed in a ghost or spirit, apart from and different from the bright sun that was dazzling his eyes?—G. P.

MISGOVERNMENT OF GREAT CITIES.

BY FRANK P. CRANDON.

[*Concluded.*]

SERIOUS as are the evils under which municipal governments are laboring, great as are the embarrassments growing out of our conservatism, the opposition of vested rights, and the clamor of charlatans and demagogues, to whom the establishment of a thoroughly honest and efficient government would be the loss of their entire stock in trade, and difficult of application as are the principles on which we must rest our plans, still I do not believe that the present situation is hopeless or remediless. I found my opinion on the conviction that a large majority of the people *desire* good government, and that, when the matter can be presented to them in an intelligible manner, they will give a cordial support to the measures by which it can be secured.

The first work, then, of those who are interested in the question of municipal reform is, after a thorough study of the subject, to formulate a system of city government which will secure all the legitimate results for which municipal governments are organized, while it reduces to the minimum the opportunities for official malfeasance.

I am informed that in Boston there is an association of gentlemen

who are organized for this purpose. I would be glad to know that similar associations were formed in each of our great cities. Through such organizations the results of the most careful study might be generally disseminated, and the public thoroughly aroused. I would be glad to make some contribution to this general purpose, even if my offering be of insignificant value.

It is manifestly impracticable for me, in this paper, to treat of the details of the subject. Permit me, however, to suggest a few general principles which, it seems to me, must underlie any successful municipal structure, whatever be its form. And first I would announce, not at all as a new idea, but as one which can not be too often repeated, or too thoroughly emphasized, that *there must be a radical and a perpetual divorce between partisan politics and the management of municipal affairs.*

There is no natural connection between these interests. A municipal corporation is purely a business institution. It has to do with matters of sanitation, with sewers, pavements, docks, police, and public buildings. It maintains parks, and to some extent regulates railroad and gas companies, and provides the city with a supply of water. It collects and disburses the public revenue, establishes and maintains a fire-brigade, lights and cleans the streets, regulates and inspects the public markets. These and all other duties which are appropriately devolved upon the corporation demand, for their successful and efficient discharge, business tact and skill, honesty, and a fair share of common sense. There is no legitimate duty which a municipal officer will perform either better or worse because he is a Democrat, a Republican, or an Independent. There is no more reason for inquiring into the political sentiments of a mayor or any subordinate municipal officer than there is for asking as to the political preferences of a bank president, a railway president, or the members of the board of directors of either of such corporations.

The city government has no political functions. It can not determine any question of finance, or tariff, or domestic or foreign policy. It is merely a business agency for managing those specific affairs which have been placed in its care, and it will be most successful and efficient when it is administered by officers who are selected on account of their special adaptation to the work which they are expected to perform.

In our country, political party preferences are frequently so strong as to control votes in favor of a candidate notoriously unfit for the position for which he has been named. The voter feels that he owes his fealty to his party irrespective of the merits or demerits of that party's candidates, and this sentiment of the voter is utilized by the office-seekers to secure a support which they could not otherwise obtain.

Not unfrequently the canvass which precedes a municipal election is simply an appeal to political preferences and party associations. The real issue, to wit, the honesty and capacity of the several candidates

to discharge the duties of the offices to which they aspire, receive next to no consideration, and in the end the success of party candidates is esteemed a fitting occasion for congratulations and rejoicing, even when the effect is to displace efficient officers by those who are inefficient.

The elimination of partisan politics from municipal affairs would be an important and a significant reform. To the place-hunters and spoilsmen of politics it would be an official "notice to quit," and it would mean that the municipal constituency had determined that the administration of city affairs should be conducted on business principles. It would help to make it practicable to secure and retain good men in the public service.

It is not often that those gentlemen, whose services either in the Council or in the executive departments of the city government are most to be desired, will undertake to secure a nomination and election through the use of the regular party machinery. The prerequisite manipulation, and the self-abasement and humiliation, which generally attend a successful candidature, demand more patriotism and self-sacrifice than even good men ordinarily possess. It is difficult to see why any man who ought to be elected should so earnestly desire the position of councilman or alderman in the city government as to be willing to pay for it what it costs in time, money, and self-respect when it comes to him as the result of a political party nomination.

When obtained, it only offers an opportunity for appropriating to the public interests a large amount of time and gratuitous service. Its only compensation must be that which comes from a sense of having faithfully and honestly discharged a duty. This is hardly sufficiently inspiring to attract the best men to the public service.

Mr. Shorey, in the pamphlet already referred to, in discussing another topic, says: "An instance will illustrate what I mean: Last spring an educated gentleman in the First Ward had faithfully served the public interests in the City Council for six years. He was not at all anxious to continue in the public service, and very properly refused to make any personal exertion to secure a renomination. The business men of that ward, in which there is probably two hundred million dollars' worth of property, paid little or no attention to the matter, and the result was the loss of an excellent representative of the character and intelligence of the city in the Council."

This is a case directly apposite to my argument. The successor to the councilman, whose loss to the Council Mr. Shorey deprecates, was the proprietor of a miserable groggery, who secured the party nomination.

Experience in former discussions leads me to anticipate here an objection which may be formulated thus: "Admitting all that you urge as to the evils of party politics in municipal affairs, and also as to the desirability of such a divorce as you suggest, there still remains the fact that they can not be separated."

The validity of this objection I am in no wise prepared to admit. It assumes that the mass of the people are indifferent to the matter of good government, and that the voters of any municipality have more regard for an intangible, ineffectual, inoperative political success than they have for the correct and efficient management of city affairs.

I do not believe that this is true. It will *seem* to be true so long as municipal elections are handed over to professional politicians and ward-bummers for management. But let the prominent and influential gentlemen in all political parties unite in an effort to elect only the best men to municipal positions; let them present only candidates of recognized ability and character; let the people be made to realize that there is absolutely no political principle involved in the contest, and the voters can not then be controlled by professional political leaders.

We are not without illustrations of the truth of this theory. In New York the good people of all political parties united for the overthrow of the Tweed dynasty, as they did in Philadelphia to depose McManes, and as they have since done in Cincinnati, and as they once did in Chicago. Under proper management these occasional and spasmodic exhibitions of non-political elections may become the rule rather than the exception, as applied to municipal governments. They tend to demonstrate the fact that the public sentiment, when properly aroused, will not tolerate official mismanagement and corruption.

Looking to this end, municipal elections should be made to occur at dates as remote as possible from those fixed for national and State elections, so that there may be the least possible complications with outside issues, and the least temptation to quote these elections as indices of political sentiment.

But more than to anything else, and, in my judgment, more than to all things else, the misgovernment of our great cities is chargeable *to our practically unrestricted suffrage.* I say *unrestricted,* because the facility with which all regulations as to naturalization and registration are evaded makes it comparatively an easy matter for any individual to vote at least once at any election.

Those cities which are constantly receiving a large influx of foreign immigration, which is both ignorant and impoverished, are the greatest sufferers, but all municipalities are placed in jeopardy by this irresponsible and unintelligent suffrage. I do not enter the lists as an opponent of what is termed "manhood suffrage" when applied to State and national elections, that is, when applied to the determination of political questions. But neither the same nor similar conditions can be predicated of municipal corporations.

I restate a proposition which has already been emphasized in this discussion, to wit, *that the municipality is a business corporation.* It may not be strictly analogous to a corporation operated for private interests, such as a great railway company or a manufacturing estab-

lishment. But that it is far more nearly allied to one of these than it is to any political institution will not, I think, be seriously disputed.

It is a joint-stock affair in which the tax-payers are the stockholders, and to them substantially should the management of its business be committed. I am aware that this proposition will be criticised as undemocratic and anti-American, but I am none the less convinced that it is logical and worthy of support.

Subtract from the body of electors that element which would be eliminated by the application of this principle, and such a dynasty as that of Tweed and Sweeney in New York, McManes in Philadelphia, and Carter Harrison in Chicago, would be an absolute impossibility.

The substratum of all ring-rule in municipal affairs is that suffrage which is subject to manipulation and purchase by adroit and unprincipled managers, and which by artful appeals may be induced to regard all property-owners as natural enemies.

The present city government of Chicago owes its existence in a large measure to the immunity that has been extended to gamblers, thieves, tramps, thugs, and communists, who, in consequence of this immunity, rally to the support of our present mayor at every election, and resort to every species of fraud in his behalf. In return, they are permitted to ply their nefarious vocations practically unmolested.

No sane man doubts that the votes of the tax-payers of Chicago would elect an entirely different class of city officers—officers who would administer the government in the interests of good citizens rather than in the interests of the criminal classes. This being admitted, is it possible that there can be any question as to which policy ought to prevail?

I do not want to be understood as including the entire non-taxpaying classes in one group, or as making any sweeping assertions which would apply to them indiscriminately. On the contrary, I know very well that many of them are among our best citizens, and entirely worthy of the public confidence and respect. I would willingly consent to any scheme which would put all good citizens in the voting class, and all doubtful or unworthy citizens into the ranks of the non-voters. I am, however, unable to devise any system which will more nearly accomplish this than the one which I have suggested, and I am unable to see how it works any hardship to any one.

None of the rights or liberties of the non-tax-paying citizen would be imperiled by his inability to vote at municipal elections. The powers of the corporation can not be legitimately exercised to his damage. If they are illegitimately so exercised, then the courts are open to his protection, and will be found vastly more efficient for that purpose than would be the power to vote.

And why is it not safe as well as equitable to commit the management of the business of the corporation to the stockholders—the tax-payers? They are the parties most directly and positively interested.

All kinds of improvements, the maintenance of good order, the security and protection of life and property, affect them more vitally than they affect other citizens. Would not a fire department which would be satisfactory to the owners of warehouses, banks, hotels, offices, commercial establishments, and costly private residences, be entirely adequate to the needs of those who own no buildings? Would not a police establishment which would serve to protect the public and private property of any large city and all its tax-paying inhabitants, necessarily be sufficient to meet all the necessities of the rest of the community?

In the matters of improving streets, and the laying out and ornamenting of drives and parks, would not the improvements made by the owners of property as a means of enhancing its value, as well as for the purposes of personal enjoyment, be a satisfactory provision for the use and comfort of those citizens who were not asked to contribute toward the expense of making them?

In many cities the cost of all such improvements as sewers, pavements, sidewalks, street-lamps, boulevards, and water-mains is charged directly on the abutting property, and are only constructed when petitioned for by a majority of the property-owners who will be called upon to pay for them. In all such cases the very existence of these improvements is a sufficient answer to the objection that public improvements would be impeded by an administration elected by taxpayers.

Indeed, it is reasonable to expect that the very opposite would be true, and that, with the assurance that public works would be managed with honesty and economy, the sentiment in favor of their construction would constantly increase.

There are two interests which I think it is probable that non-taxpaying citizens would be unwilling should be left entirely in the hands of their tax-paying neighbors. I refer to the provisions to be made for general education, and the proper and sufficient care of the poor.

I do not personally feel that even these interests would thus be in any degree jeopardized. They might, however, be so guarded and protected in the organic act of incorporation as to be placed absolutely beyond any danger.

What would be the result if, in our great railway corporations and large manufacturing companies, the board of directors, instead of being chosen by the stockholders, were to be elected by the employés? What would be the relative probability of securing a competent and efficient management? There could be but one outcome to such a policy: stockholders and employés would soon be involved in one common ruin. Query, Can the municipal corporation, acting under a similar policy, escape a like disaster?

But here, again, I expect to meet the objection once before noticed, viz., that the plan, whatever be its merits, is an impracticable one.

It will be said that where the elective franchise has once been conceded it can not be recalled. I recognize the difficulties of the situation, but I do not admit that they are insurmountable.

Instances are numerous where guards, limitations, and restrictions have been imposed upon the elective franchise by legislative authority, and it is but taking another step in this direction to establish the principle which I have been advocating.

No one will dispute that it is entirely competent for the Legislature, when organizing municipal corporations, to prescribe the conditions under which the elective franchise shall be exercised. If, then, the legislators should come to approve this method, it could readily be applied in erecting future municipalities.

In the case of cities like Boston, St. Louis, Cincinnati, etc., where there are two legislative bodies in the city government, we might, perhaps, make one of them elective by the popular vote, and the other by a vote of the tax-payers only. It might be required that appropriation bills and bills for raising the revenue should receive the approval of both bodies. Then, by-and-by, when the people shall have come to the conclusion that only one legislative body is needful, they might decide to retain the one elected by the tax-payers and abolish the other.

Or, without in any way interfering with the right of suffrage in the case of any one who is now a voter, it might be determined as to any one who is not now a voter, that he shall not hereafter be entitled to the municipal franchise unless he be a tax-payer.

If the principle be correct, as I believe it to be, and if it be accepted by thoughtful men as one of the conditions of honest government, the *method* by which it may be incorporated into the municipal system will be devised. The method which has just been adopted by Chicago for securing fair elections will doubtless help to correct many of the evils which arise from what I have characterized as an *unrestricted suffrage*. The operations of this new election machinery will be watched with great interest by all who take an interest in municipal affairs, and it may be that from this source our deliverance is to come.

I notice one other particular in which reform in municipal governments is imperatively demanded: that is, *the consideration which is given to the needs of the proletariat*. The truth of the aphorism, "No man liveth to himself," more and more imposes itself on the attention of thoughtful men. It is a truth which neither individuals nor aggregations of individuals can afford to ignore.

The first problem in social science ever submitted for consideration was, "Am I my brother's keeper?" It would seem as if ever since that time the world had been endeavoring to find a negative answer to the question. No such answer has been found. No such answer can ever be found, because the law of reciprocal obligation is always

operative in society. Evade the subject as we may; put it aside and refuse to consider it, as so many do; characterize it as Utopian, or sophistical, or chimerical—nevertheless it constantly reasserts itself with the declaration, "The voice of thy brother's blood crieth unto me from the ground."

We may wrap ourselves in a mantle of selfish exclusiveness and refuse to recognize these obligations, but ever and anon the jostling of passing events will remind us of neglected duties.

Our responsibilities in this regard are not confined to legal formalities nor bounded by them. They have to do with our relations as members of one common brotherhood. Our employés have claims upon us in addition to the stipulated compensation for services rendered and our recognition of their technical rights—claims upon our sympathy with their sufferings and misfortunes; claims to our encouragement in all their efforts for improvement, and to our helpful care in every time of need.

The claims of our neighbors who are not our employés are equally valid and imperious. Personal interest, as well as our obligations as good citizens and honest men, forbid us to ignore these claims. There is a tendency prevalent in society to limit these obligations by the narrowest possible lines.

Men look askance at the various manifestations of evil in the community, and, instead of planning and working for the correction of the evil, they spend their thoughts and efforts in devising better safeguards for their personal interests, in the vain hope that, when the storm does come, their defenses will be found sufficient. When the ruin comes, however, the strong and the weak are involved in one common catastrophe.

The granger organizations which a few years ago wrought such disaster to the railway interests of the Northwest, the strikes prevalent in connection with mining and manufacturing industries, and the riotous demonstrations and destructive agencies of the commune, serve as illustrations.

We were lately receiving the details of what was termed the working-men's insurrection in London. We see how easily such a movement passes under the control of socialistic and communistic leaders, and how readily it is transformed from a popular demand for employment into an ungovernable and devastating mob.

Doubtless a large fraction of this assemblage was made up of the criminal and base elements of society, but another large fraction was composed of those who had neither bread nor an opportunity to earn it—men who would be peaceable and industrious if only they could be given a chance to provide food for themselves and for those dependent upon them.

It was the discontent and sense of wrong upon the part of this element that made the riot possible. I am very far from offering any

justification for such demonstrations, or excusing such acts of destruction or violence. But I want to call attention to this source of danger and menace to the good order and peace of society, and the security of property. An unemployed and more than half-starved element in any community is a slumbering volcano which at any moment is liable to a violent and destructive excitement. In the rapine and desolation that follow such an eruption, we see the result of ignoring the obligations to which I have referred—obligations, indeed, that are not recognized by our laws, and such as can not be enforced in any of our courts, but which are of a character that transcend all human law, and reside in that relationship which the Creator has established between men.

Take away the conditions of suffering and want which are coincident with an unemployed laboring class, and both the pretext and incentive to such demonstrations will be wanting.

But hungry men are neither philosophers nor political economists. Both themselves and those who depend upon them are in the direst need. Food and wealth are plentiful, but in the midst of both they are dying from want. Is it strange that under the promptings of their necessities they come to regard wealth as their enemy, and its possessors as in league against them, or that they determine to obtain relief without reference to the legal rights of those who may for the time being be the owners of that which they so much need?

We deprecate these outbursts. They ought to receive the severest condemnation. Their effect can only be to aggravate the very difficulties by which they are inspired. But let us remember that they have their origin, to a very considerable extent, in the indifference of society to its obligations to the laboring classes, and that society can only be made secure by recognizing and discharging these obligations.

The recent labor-strikes, culminating in the dynamite murders at Haymarket Square, in Chicago, should not, in my judgment, be classed with the London demonstration.

The labor difficulties occurring throughout the United States, in the first half of A. D. 1886, have a different purpose and origin. They are the first manifestations of a plan to establish an oligarchy of workmen. A secret organization was established, on the theory of unquestioning obedience to the mandates of its leaders. Its members were made to believe that the organization was potent and beneficent. Under the pretense of protecting labor, these leaders assumed to dictate and control the actions of laborers, after a fashion more odious and tyrannical than was ever before known among civilized men. Large numbers of working-men were deceived by the professions of these demagogical leaders. Others were intimidated and dragooned by the power of the organization, and thus these pestilent fellows of the basest sort were enabled for the time to set at defiance all law, to

trample upon all rights of property and person, and institute a reign of anarchy and destruction.

The spirit of revolution and disorder pervaded the whole movement, and justified the most prompt and aggressive action on the part of the police and military authorities. It is to be hoped that the civil law, in the legitimate exercise of its power, may permanently relieve society from the presence of these leading anarchists.

The municipality, too, is charged with certain obligations to its proletariat. On the proper discharge of these obligations, the contentment, sobriety, and good citizenship of the community will very largely depend. Among other things, it ought to be the care of the city that the houses built for the accommodation of this population are suitably constructed, with a due regard to the health and comfort of the inmates; that the streets where they live are properly lighted, and sewered, and cleaned; that they have an ample supply of pure water; that public baths are established for their use; that libraries and reading-rooms are established for all who will use them; that public parks are established, with some reference to the convenience and comfort of this part of the people; and that some simple entertainment, such as music in the parks, be furnished for them.

The expense both of time and money which might be involved in carrying out these and such other plans as would be instituted in behalf of this part of the city's population, would afford the most ample returns, even when considered as an investment. It would lessen the amount of disorder and crime. It would reduce the demands made upon the hospital and poor-relief funds, and it would increase the value of taxable property.

There would be no quarter of the city which was practically assigned to the criminal and degraded classes—no localities which would have the reputation of the Old Five Points of New York, or the Levee of Chicago. I do not mean that we should in this way remove all destitution, degradation, or crime, but that we would reduce these evils to their smallest dimensions; that we would advance every material and social interest of the city, and would discharge a duty that is devolved upon us by the claims of humanity, the instincts of self-interest, and the principles of the wisest political economy.

FULGURITES, OR LIGHTNING-HOLES.

By GEORGE P. MERRILL.

THE peculiar and often disastrous results attendant upon an electric discharge have been dwelt upon since time immemorial. To even briefly refer to the numerous recorded instances of the destruction of life and property by the discharge of "heaven's artillery"

would far exceed the limits of this paper. It is my purpose, therefore, to call attention only to those peculiarly interesting, though usually quite harmless, effects produced by the lightning striking in loose sand; though, before closing, I shall allude to the closely allied phenomena resulting from similar discharges upon solid rock. In the sand, as is well known, the usual result produced is that of fusion, whereby a frail, glassy tube of variable diameter and length is produced, the interior of which is a true amorphous glass, quite smooth, while exteriorly it is roughly granular and greatly corrugated. Such are called *fulgurites* or *fulmination-tubes* in English, while, to the German and French, they are known as *Blitzröhren* and *tubes fulminaires* respectively.

So far as can be learned from available literature, the earliest description to be made of these peculiar objects was that of Pastor David Hermann in 1711. According to Gilbert,* this gentleman, as early as 1706 and 1707, dug from a sand-hill in Massel, Silesia, fulgurites some twenty feet in length, which he very fully described in his work on Massel and its curiosities.

Hermann's account is curious and full of interest, as his statements concerning the origin of the tubes were the purest guess-work, and his views regarding them wild in the extreme. He designated them by the name "Osteocolla," and proposed to use them for medicinal purposes, as will be noted later.

The earliest account of an occurrence of this kind, where the fusion was indubitably proved to be due to lightning, is that of Mr. Withering, in the "Transactions of the Philosophical Society of London for 1790." In the narrative as there given, a man, who had taken refuge beneath a tree at Aylesford, England, during a thunder-storm, was instantly killed and his clothing set fire from a flash of lightning, which first struck the upper portion of the tree and thence passed downward toward the ground. A portion of the electric fluid, after leaving the man's body, passed down a walking-stick held in his hand and thence to the ground, where it made a hole some two and a half inches in diameter. The first ten inches of this hole presented nothing worthy of remark; at this point, however, the fluid was found to have followed along for some eight inches the root of a tree which presented itself, and which, aside from a slight superficial blackening, was unharmed. Some closely adjacent quartz-pebbles did not, however, escape so easily, but were found with their corners and angles very considerably rounded by fusion. The hole was traced only to a depth of about eighteen inches, and no real tube is mentioned as having been discovered.

The next account which we have to notice is that given by Dr. Fiedler,† who describes in detail the finding of fulgurites by Dr. Hentzen and others in the great sand-wastes of Paderborn, common-

* "Ann. der Physik.," B. 61, 1819, p. 249. † Ibid., vol. lv, 1817, p. 121.

ly called Senne. He also describes them as having been found in similar situations in Pillau, near Königsberg, in Prussia; at Nietleben, near Halle; and at Drigg, in Cumberland, England. In a subsequent paper, two years later,* he further describes other tubes found at Rheine, in the bishopric of Münster, in Prussia; the sand-hills of Regenstein, near Blankenburg, in the Harz; and near Bahia, in Brazil. Fiedler is followed in his turn by Gilbert, † who gives a history of the finding of the fulgurite at Massel, as above noted, and also those of Bahia, in Brazil. An excellent *résumé* of the matter up to 1821 is given in the "Ann. de Chemie et de Physique" for that year, ‡ and also brief descriptions of the fulgurites formed on solid rock, as described by Saussure and Humboldt.

The tubes found in Cumberland were three in number, and were formed in a white and reddish quartz-sand, in which were a few pebbles of "hornstone porphyry." One of the tubes was followed down to a depth of twenty-nine feet, where it came in contact with a fragment of the porphyry, and glanced off at an angle of about forty-five degrees. The surface of the porphyry fragment was somewhat fused, forming an olive-green glass. Beyond the fragment, the tube resumed its vertical direction, but became weaker and easily broken. The caving-in of the sand prevented exploration to a greater depth. One of these tubes was two-pronged, and the main branch was again divided into two, while small, lateral branches, two or three inches long, were given off at intervals.

The account of the occurrence and appearance of the tubes found at Massel, as given by Hermann in 1811, and as quoted by Gilbert, is as entertaining as it is inaccurate. He says: "The glass-like tube resembles molten glass or iron. It grows in yellow sand from the depth of the earth at Massel, on the south side of the Töpel Hill, and also in the Ellgutten wood, and on the high sand-hills close to the village of Klein Schweinern. The tube has sometimes the thickness of a finger or a thumb; at other times it is as thick as a quill-pen, and the deeper one goes, the thicker and stronger it is found (?). Its constituent parts are very soft when underground, but soon become hard by exposure to the air, and have the appearance of a gritty, ash, or iron-colored enamel, glisten like crystal at the point of fracture, give a clear, ringing sound, and cut glass. It is hollow, shines like glass, and has a reddish-brown color. It is not found near the surface, but only after digging several ells into the ground. In the months of May or June it naturally pushes upward, and crops out of the sand. This point afterward breaks off of its own accord, or is knocked off by the feet of passing people, cattle, or vehicles, by means of which many a beautiful piece is found" (?).

* "Ann. der Physik.," vol. lxi, 1819, p. 235. † Ibid., vol. lxi, 1819, p. 249.

‡ "Sur des tubes Vitreux qui paraissent products par des comps de foudre." "Ann. Chem.," etc., p. 290.

Passing by, for lack of space, the interesting accounts given by Darwin* and Fiedler† of fulgurites found at Maldonado, near the mouth of the La Plata, in South America, and in a vineyard on the right bank of the river Elbe, and simply noting the finding of similar tubes at Northfield Farms, Massachusetts, in 1861,‡ we will mention the next recorded occurrence at Macclesfield, England,* which, like that of Cumberland, is remarkable on account of the length of the tube found. This is described as three fourths of an inch in diameter at its upper end, and tapering gradually throughout its length to within three or four feet of its lower end, where it assumed a slanting direction, and then divided into several filaments or branches, and became dispersed and obliterated in the soft, spongy soil. This fulgurite was traced to a depth of twenty-two feet in a straight line, and gives us a good illustration of the immense heat and power of penetration of an electric discharge.

The occurrence described by Roemer,‖ of twenty-five sets of fulgurite tubes, within a space of one hundred by two hundred yards in the great sand-flats of Starczynow in Poland, is, I believe, the most remarkable on record. The sand in this case was a very pure quartz-sand with a few pebbles of rolled flint ("Feuerstein").

The tubes were found with their upper ends exposed, owing to the blowing away of the loose sand, and varied in size from the thickness of one's arm to that of a wooden knitting-needle, while the thickness of the tube-wall varied from one to two millimetres, rarely more.

An article by the present writer△ gives a detailed description of fulgurites from Santa Rosa Island, Florida; Sumter, South Carolina; and Union Grove, Illinois, now in the collections of the National Museum.

Those from Santa Rosa were formed by the lightning striking a small pine-tree, and thence descending to the ground, where, at a distance of about forty feet from the trunk it formed a tube, which occurred as a crooked, irregular line along the surface. This was nearly pure glass, grayish in color, translucent, and very free from corrugations, though in some cases completely collapsed. The small fragments of the tube from Sumter, South Carolina, were found while digging a well at a depth of twenty feet below the surface. The tube-walls were very thick and strong, brownish and opaque. They lacked the corrugations, but had, externally, rather the knotted appearance compared by Gümbel to that of stag's horns. The great amount of material received from Union Grove, Illinois, shows this to be proba-

* "Voyage of H. M. S. Beagle."

† "Comptes Rendus," vol. xvii, 1843, p. 216.

‡ "American Journal of Science," vol. xxxi, p. 302.

* "Geological Magazine." 1865.

‖ "Neues Jahrbuch für Mineralogie," etc., 1876.

△ Shortly to appear in "Proceedings of the National Museum," vol. ix, 1886. This article gives also a very full bibliography of the subject.

bly the most extensive find of fulgurites yet noted in this country. The locality where they occurred is the top of a sand-hill some fifty feet square. Several sets or pairs of tubes were found here, but a few inches apart, together with several small, irregular masses of fused material, the largest of which weighed several ounces. The largest tube found was about three and a half inches in diameter, but was too frail to remove. The accompanying plate shows the characteristic forms.

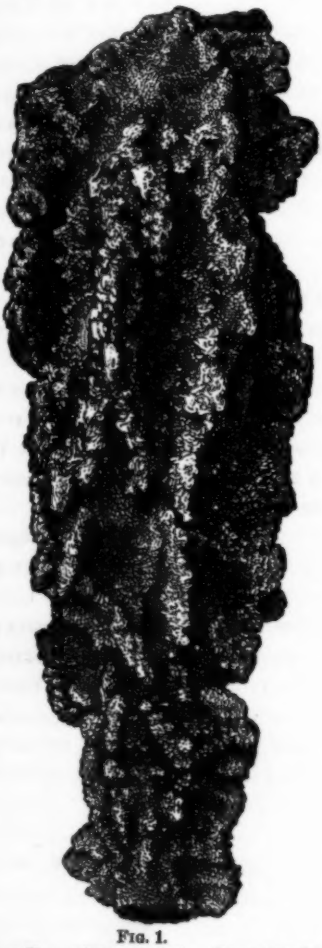


Fig. 1.

Fig. 2.

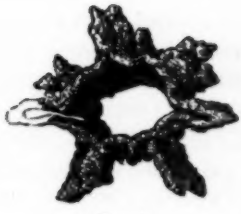


Fig. 3.

Fig. 4.

Fulgurite Tubes (natural size). (Reproduced from Proceedings of the United States National Museum, vol. ix, 1886.) Fig. 1, portion of tube, common form; Fig. 2, tube with bulb-like enlargement; Fig. 3, cross-section of tube, characteristic form; Fig. 4, holes fused by lightning in sheet-copper, and resembling fulgurite tubes in outline.

One of these was traced into the sand for a distance of about seven feet, and was found to increase in size slightly from above downward. They were frequently branched, and often sent out small, nearly flat horizontal branches or shoots, about one quarter of an inch wide, and

half as thick, the greater diameter being horizontal. The hole in these was quite small, and closed abruptly at the end. Fig. 2 is peculiarly striking, and seems quite different in form from any yet described. These "bulbs" are said to correspond with the stratification in the sand.

Concerning the microscopic and chemical properties of the fulgurite, little seems to have been done until within a comparatively recent period. In 1875, Harting* examined some fulgurites found in a cornfield at Elspeet. He describes these as vitrified tubes, having a form scoriaceous, rough, and very irregular. Exteriorly they were coated with sand and carbonaceous particles, while interiorly they were of a white glass which was sometimes streaked with brown or black, a coloration which he judges to be due to distillation products from the vegetable matter in the sand. A complete chemical analysis of the fulgurite yielded results as follows: SiO_2, 90·2 per cent; Al_2O_3, 0·9 per cent; Fe_2O_3, 0.7 per cent; CaO, 0·1 per cent; MgO, 0·5 per cent; K_2O, 0·5 per cent; NaO, 0·6 per cent; insoluble in HCl, 0·9 per cent; carbonaceous matter, 5·6 per cent.

Discussing the results, the author argues that the alkalies and other bases, belonging to the vegetable matter, have been driven off by the heat of the flash, since the percentages shown are not greater than is contained by the sand itself. He also conceives that the presence of these bases may have aided in the reduction of the refractory silica—an idea which seems to have also been adopted by Gümbel and Wichmann. When, however, we consider the extraordinary brief duration of the flash and heat, this reaction seems scarcely possible.

Gümbel† describes fulgurites from the Libyan Desert between Dachel and the Ammon Oasis, in which the tube-wall consists of an amorphous glass enveloping unfused quartz-kernels. A partial chemical analysis led him to conclude the interior lining to be a true *quartz* glass. To this conclusion Wichmann‡ takes exceptions. This gentleman pulverized portions of the fulgurite tubes from Senner Heide, from Elspeet, and from Starczynow, and by means of a solution of great density# succeeded in separating the glass of the fulgurite from the inclosed sand. Chemical analysis of this yielded silica as follows:

Senner Heide	96·44 per cent.
Elspeet	94·26 " "
Starczynow	91·23 " "

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* "Annales des Mines," vol. viii, 1875, p. 700.

† "Zeit. der deutsch. geol. Gesell.," vol. xxxv, p. 648.

‡ "Zeit. der deutsch. geol. Gesell.," vol. xxxv, p. 849.

The solution in common use by lithologists, for separating finely powdered minerals of different specific gravities, is a saturated solution of the iodides of mercury and potassium. Properly prepared this can be brought to a density sufficient to float any substance of specific gravity not greater than 3·25. By gradually diluting the solution and thus rendering it less dense, it is possible to separate the various minerals of a powdered rock with a considerable degree of accuracy.

Thus proving that the glass was not a pure *quartz* glass. Owing to the small amount of material at his disposal, the other constituents could not be determined.

As viewed in their sections under the microscope, this glass was completely amorphous, showing only a few partially fused grains on the outer portion. There were no traces of crystallization products from the fused magma, the duration of the heat and the cooling following being too brief and too rapid for their productions. It was, however, filled with cavities of varying sizes, formed by the volatilization of the moisture in the sand at the time of the formation of the tube.

In the paper by the present writer, already referred to, the composition of both the fulgurite glass and the sand in which they formed is given as follows :

CONSTITUENTS.	Glass.	Sand.
	Per cent.	Per cent.
Ignition	0·33	1·00
Silica	91·66	84·83
Oxides of iron and aluminium	6·69	9·88
Calcium oxide	0·38	1·16
Magnesium oxide	0 12	0·13
Potassium oxide	0·73	1·13
Sodium oxide	0·77	1·15
Total	100·68	99·64

Thus proving conclusively that, in this case at least, the glass was not a pure quartz glass, although it showed itself to be richer in silica than the sand from which it originated—a result which, to say the least, was hardly expected.

Discussing the results of the above analyses, the writer concludes that the composition of the fulgurite glass is dependent entirely upon the conducting power of the various mineral constituents of the sand, regardless of their fusibility ; that the glass, showing a larger proportion of silica than the sand in which it forms, points to the fusion of the siliceous (i. e., the quartz) grains, in preference to the feldspathic and ferruginous ; hence, that the quartz-grains were poorer conductors of the electric fluid than were the others. This may, perhaps, be in part accounted for from the fact that the feldspar-grains were partially kaolinized, and hence held more moisture, which would render them better conductors.

It is not at all strange that at first many opinions prevailed regarding the nature and origin of the fulgurite tubes, and that some of these were peculiar in the extreme. Pastor Hermann seems to have gone farthest astray, for he says : "This growth (i. e., the fulgurite) is undoubtedly the product of a subterranean fire, whereby not only this tube is formed through melting sand, *accedente viscoso quodam fucco*, but also the two springs at Massel and Ellgutt, between which this tube is found, are warmed by the same fire."

As already noted, he designated the fulgurites by the name of *vitrified Osteocalla*, or *Ostecolla Masselsis*, and proposed to utilize them for medicinal purposes, placing them in the same category as deer-horns, crab's eyes and corals, which at that time were considered as excellent for all kinds of "fevers, virulent and febrile diseases." The finding of the molten quartz directly in the track of the lightning at Aylesford, England, as described in the "Philosophical Journal" noted, was accepted as proof positive of the electric origin of fulgurites by Fiedler and most others. Nevertheless, Dr. Clark, of Cambridge, in one of his public lectures in the year 1816, took occasion to deny this method of origin regarding the fulgurites of Drigg, and contended that they were but concretionary forms lined interiorly with a mineral resembling hyalite or pearl sinter. Dr. Fiedler fully discusses all possible source of origin, including the probability of their being incrustations on roots, sinters, or other mineral products, or aggregates of ancient sea-worms, and finally proves, apparently conclusively, their origin from electric fusion, an origin concerning which there can at present be no doubt.

The cause of the frequent occurrence of fulgurite in sandy plains, which seemingly present but little attractive force to the electric fluid, has been frequently discussed. Fiedler ascribed it to the fact that at certain depths below the surface there are little portions of water, and the tubes are produced by the passage of the fluid from the surface to these portions, where it becomes neutralized. Darwin, writing of the Maldonado fulgurites, thinks it probable that in that particular instance the flash divided into two or more branches before entering the ground, rather than that they were formed by several distinct discharges. To the present writer, the explanation suggested by Roemer, regarding the extraordinary find at Starczynow, seems most probable. Here it will be remembered that some twenty-five tubes were found in a space one hundred by two hundred yards. Roemer calls attention to the fact that these may have been formed at intervals of even hundreds of years; also to the equally important fact that the lightning, although striking with the same frequency in less exposed places, might fail to produce the tubes, owing to the character of the soil, or, if so produced, they would be obscured by leaves, soil, etc., instead of having their upper ends exposed by the drifting away of the sand.

The deeply corrugated, or winged, and otherwise peculiar form of the fulgurite tubes, has been a matter of some speculation. Darwin, as already noted, considered it to be due to the pressure of the sand acting while the tubes were still plastic—a view which has been in many cases adopted by subsequent writers. Fiedler and Harting, on the other hand, considered that the size and form of the tube, or, in other words, the shape of the bore of the lightning, was largely dependent upon the vapor engendered from the water in the sand at the time

of the flash. Indeed, these authorities considered the presence of water in the sand as essential to the formation of the tube. Wichmann does not fully acquiesce in the view that the wings are produced by the collapsing of a portion of the tube-walls, but considers them as original formations.

That they are not due simply to collapsing is the opinion of the present writer. In the article quoted he there expresses the opinion that the irregular form of the tube near the surface is due to the exceeding energetic action of the current during this part of its course, and the lack of homogeneity in the conducting material. At depths of a few feet below the surface, where the force of the current had become to some extent reduced, and the sand was more compact and homogeneous, the tube was found more nearly cylindrical.* It is very probable that steam may have been instrumental in producing the bulb-like enlargements so commonly found, but it can scarcely be considered as essential to the formation of the tube itself.

We have next to notice the fulgurites produced upon solid rock. These, as can readily be imagined, differ from those produced in the sand, in being of but slight depth, and frequently existing merely as a thin, glassy coating on the surface.

G. Rose† describes fulgurites of this nature as occurring in abundance upon the summit of Little Ararat, in Armenia. The rock is an andesite, somewhat soft and porous, and it is stated that blocks a foot long can be obtained, perforated in all directions by the irregular tubes, from three to five centimetres in diameter, which are filled with a bottle-green glass, formed from the fused rock.

A small specimen of this rock, deposited in the National Museum,‡ has much the appearance of a rock bored by the teredo, the holes in which have subsequently been filled by the green glass. It is stated by this writer that, in fulgurites collected by Humboldt from the Punta del Fraile, in Mexico, the fused mass of the walls had overflowed the tubes upon the surrounding surfaces. Saussure describes fulgurites as occurring also in the hornblendic schists of Mont Blanc, and Ramond mentions similar occurrences on Monts Perdu and Pic du Midi in the Pyrenees, as well as upon Mont Auvergne in France.#

Wichmann‖ examined the Ararat fulgurite glass with the microscope, and found it to agree closely with that of those formed in loose sand, being completely amorphous without trace of microlites, and in containing numerous steam cavities.

* He also shows that, even in so homogeneous a material as sheet-copper, the hole produced by electric fusion is not in all cases circular in outline, but is often quite irregular, closely resembling a cross-section of fulgurite tube. (See Fig. 4 of plate.)

† "Zeit. der deutsch. geol. Gesell," vol. xxv, p. 112.

‡ The property of Mr. J. S. Diller.

"Ann. de Chim. et Physique," Bd. xix, p. 155.

‖ "Zeit. der deutsch. geol. Gesell.," vol. xxxv, p. 858.

Dr. Gilbert describes* the fulgurites found by Humboldt upon the high peaks of the Nevada de Toluca, in Mexico. The rock on which they were found is described as a *trap porphyry* taken from the summit of the Pic del Fraile at a height of 2,364 "toisen" (about 4,621 metres). Masses some two feet square are said to occur covered with a thin layer (about one half of a millimetre) of a pistacio-green glass. In one instance, where a feldspar crystal intervened, the glass was white. The peculiar shimmer of this glass in the sun led Humboldt to ascend this precipitous peak even at the risk of his life. In many places the rock was completely pierced by small cylindrical tubes, which were lined with the same greenish glass, and this was found to resemble closely the glass from the inner walls of the tubes found at the Senner Heide.

The most interesting and, so far as I am aware, the only investigation of this kind undertaken in America is that of Mr. J. S. Diller on fulgurite from Mount Thielson, in Oregon.† The summit of this mountain is described as being composed of a hypersthene basalt, very precipitous and difficult of ascent. The fulgurite occurs both as a superficial coating on the rock, and in the form of tubes. "Although spread over a considerable surface, it is not evenly distributed, but is arranged in patches of drops and bubbles of glass in very much the same way as paint which has been put upon a greasy surface." The glass is described as translucent and of a greenish color. In places the tube penetrated the rock to a depth of a few inches, having a diameter of from 10·5 to 20 millimetres. These have a glassy lining of some two millimetres in thickness. The tubes are not regarded as having been produced by the lightning itself, but to be pre-existing tubes and cavities (the rock is naturally spongy), into which the fluid passed and fused the walls. The chemical composition of this glass was found to be silica, 55·04 per cent; alumina and iron, 28·99 per cent; lime, 7·86 per cent; magnesia, 5·85 per cent; potash and soda not determined; loss by ignition, 1·11 per cent; total, 98·85 per cent. This was also found to be practically the composition of the groundmass, or non-crystalline portion of the rock.

The fulgurite found on the summit of Dom du Gonte, one of the peaks forming a part of the chain of Mont Blanc, has been recently described by Rutley.‡ The rock is represented as a hornblendic gneiss. The fused material formed merely a superficial coating in the form of attached globules or irregularly fused pellets and blotches of brownish, black, or white glass. The white glass resulting from the fusion of the feldspar, while the dark in like manner was of hornblendic origin. This occurrence of the two glasses, unmixed even

* "Ann. der Physik.," B. 61, 1819, pp. 261 and 315. See also "Ann. de Chim. et de Physique," pp. 281 and 299.

† "Am. Jour. Sci.," vol. xxviii, October, 1884, p. 252.

‡ "Quar. Jour. Geol. Soc.," vol. xli, 1885, p. 152.

when in actual contact, well illustrates the extreme rapidity of the whole proceeding, "the fused surface of each mineral having cooled almost exactly *in situ*." In nearly every other particular the observations made on the glass corresponded with those above noted.

In conclusion, it may be said that a careful examination of high, isolated mountain-peaks and areas of loose drifting sand will doubtless result in the discovery of many more of these interesting phenomena than have yet been reported.

VIEWS OF LIFE IN THE CRAZY MOUNTAINS.

By Mrs. E. D. W. HATCH.

SOME months ago, looking in the direction of the foot-hills, I saw a "jack-rabbit" making its long leaps toward its home, white as the snow around it; but for its sudden springs in the air, it would hardly have been distinguished from the earth's covering.

By a curious provision of Nature, this animal, much larger than the common rabbit, changes its color in cold weather, in common with some others, and with some classes of birds. This is not the case with animals that hibernate, or slumber through the winter, as the bears. The change of color seems to act as a safeguard to protect the animals from their natural enemies. The coyote likewise becomes nearly white in winter, or very light colored. The antelope is also much lighter in these northern latitudes in winter. A *white* deer was killed in Yellowstone Park last December; this absence of color was probably due to a freak of Nature. The jack-rabbit often retains color in its ears when the rest of its body is entirly white. A smaller species of rabbit, commonly called the "cotton-tail," does not change. Besides the animals already mentioned as having this property, five or six species are similarly peculiar—the ermine, weasel, and hare; the latter somewhat differing from the jack-rabbit. Of the feathered creation the ptarmigan, a species of grouse, shifts its summer clothing for light feathers in the winter. Wolves have been uncommonly plentiful during the last season; why, when there are so many more hunters, is hard to say, unless it is that their larder is better supplied by so much additional stock being in the Territory. The strategy of these wolves is remarkable. That they have, in common with many other animals, some method of communicating with each other, and laying plans, is evident. Many a band of horses loses largely by their wounding and carrying off young colts. A young colt, however, is rather a stupid, staring sort of an animal—not blessed with ordinary animal presence of mind, or obedient enough nature, to heed maternal warnings and escape with the rest of the flying band when the wolves attack them. These ferocious animals will hang around a lot

of cows, and making selection of one, two, or three of them, will go in front of the cow, and by fierce attack seek to separate her from her calf and distract her attention, while others sneak behind and disable or kill the calf. If the cow is a good fighter and drives them away from the wounded calf, they bide their time until she is obliged to go for a drink or food, and then have a feast upon veal. Their method of chasing the antelope shows that they understand well the habits of different animals. An antelope when running takes a circle of two or three miles, and then returns to the starting-point. So the wolves combine and establish relays (as it were) on this circle: the first leaders running the frightened animals half a mile, perhaps, they drop out, and the next relay does the same, and thus by relays they worry the antelope until it falls exhausted; they then give a peculiar cry or bark, a summons which calls the pack together to the feast. It is a fine sight to look upon a number of antelopes running freely across the hills, now out of sight in a hollow, then leaping, heads up, over the ridge, showing enjoyment in every motion. Often, when one is out riding, they will run parallel to the road, or the carriage, a long way. They are not wise animals, and often fall victims to their curiosity. A red rag on a stick thrust in the ground, or some other small object attracts them: they stop to look, get closer to investigate, and are thus brought within gunshot of the wily hunter lying in ambush who prepared the decoy. There was a time, on the ranch, when we were subject to the depredations of some animal carrying destruction among the sheep after they were put up for the night in one of the corrals near the hills. This corral, in which one of the "bands" was inclosed, was about four miles from the house, the herder in charge having a cabin close by. The dogs did not make the usual disturbance, but seemed completely cowed when the robber was about. This sign, as well as some others, seemed to indicate that the foe was a mountain-lion. The creature kept carefully out of sight, but managed to raid at night, with much destruction; so the owners and herders in turn mounted guard at night, armed. The wary creature did not approach the inclosure while it was thus guarded, but it was evident he was near, though never seeming to come by the same path twice, and watching the guard. One of the men left his post at daylight, but before sunrise the enemy seized the advantage and killed a sheep for his breakfast. Another morning the herder having been on guard, went in for his morning meal, thinking all safe. Hearing a suspicious sound he sprang to the door, and opened it, but too late, as the form of a beast disappeared in the brush. After a little time a light snow fell, and an endeavor was made to track the unknown. Following up the mountain-side at length, upon a hill, in rather a secluded, rocky place, commanding a good lookout, the beast's lair seemed to be found, but he was not at home. Poisoned meat was several times placed conveniently for him, but, though it seemed sometimes to have been carried

away, it was plain he did not taste it, as he still did his own slaughtering when there was opportunity, and the shots fired into the brush never hit him. At length, however, he must have been tempted, and poison beginning its work, Mr. Lion made his last leap into the corral, killed two sheep, and died by their side. The men placed him in a wagon and brought him to the house for exhibition. He measured nine feet from the tip of his nose to the end of his tail, and had a cat-shaped head and ears, tremendous paws, and a dull-yellow color. It is said the mountain-lions of the Black Hills are striped with white, particularly on the face, but this was not the case with the one of which I write, the only one I have ever seen. It seems a misnomer to call this creature a lion, even with the prefix mountain. He does not have a den, but "lies around" wherever he can make himself comfortable, sometimes living chiefly in an abandoned "*wickey-up*," a deserted shanty in the brush, among the rocks, or in a "coolie," and always on the watch. It is said they will not attack a person unless cornered, but I think one who trusted this certificate of character might have cause to repent. Stealthy animals with such characteristics are not to be trusted. *Our* lion, set up by a taxidermist, was one of the attractions of the park last summer, and is probably one of the largest specimens of his race. Sheep-owners have much to contend with in this part of the country, and wild animals seem to have ways of their own, with a ready adaptation of habits of mischief to circumstances. The home corral outside the yard fence, and but a little way from the house, contained at one time some two thousand sheep. There was a fence around it, as well as about the house. Temporarily a few valuable sheep were placed at night in the yard. The bears came down at night, like the Assyrians of old, but instead of going to the outside corral, which was far the handiest for them, they boldly under cover of the darkness, came into the yard. The dogs gave the alarm, waking every one on the place, but, before the men could get out, the bears had killed seven sheep, and it seemed in pure wantonness mangled others so that they afterward died. It was rather an uncommon thing for these animals to venture so near a house.

The sheep-dogs deserve more than a passing mention. Their intelligence and quick apprehension of what is required of them, and faithful performance of duty, are wonderful; without them, the working force for sheep would require to be more than doubled. They appreciate kind treatment, and take to heart scolding and abuse. No surly or cross man to the dogs should be allowed among sheep. A foreman of a sheep-ranch told me that, in sending out a new man, he assigned an old dog to him, thinking, if the man did not know his duty, the dog did. He charged the would-be herder to be kind to the dog, and said, "He will not stay with you if you are not." In two days the dog was at home again. The foreman visited the man, taking another dog, and said to him: "You were cross to the old dog, and I told you

he would not stand it; you can't get along without a dog." "I was not cross to the dog; but, confound him, he would not even let me *swear at the sheep!*"

When spring approaches we are reminded that even here, in the rocky hills and desert-lands of sage-brush, cactus, and alkali-springs, Nature is not sparing of her gifts, and these arid hills and plains show forth many floral beauties.

Among them is one that claims universal admiration when seen in flower, belonging to the primrose family, said to be named for its discoverer, Lewis the explorer, *Lewisnia*, growing wild in the sand and gravel of the rocky ledges of the foot-hills, mostly on the southern side. The leaves are coarse, radical, and from four to eight inches long. The root stretches several feet, fleshy and red, with two or three side or lateral roots. It may be that this plant is the same as that mentioned in a report to the United States Agricultural Department among the "Food-products of the North American Indians in California," called in the report *Lewesia rediviva*, and by the Indians "spatulum." The root of this plant is described as large and spindle-shaped, its inner part white and farinaceous; and the report continues: "It abounds in concentrated nutriment, a single ounce of the dried article being sufficient for a meal. It is worthy of cultivation." Perhaps, being cultivated, it might take rank with the potato. It has rare floral beauty; the buds spring from the crown of the root, the leaves of the plant spreading around flat on the ground; the buds grow nearly upright, from one to two inches in length. If you watch them about sundown, you can see the buds slowly expand, and soon open into a pure white flower, four- and five-petaled, rose-scented, containing long stamens and pistils covered with pollen. The flower expanding near nightfall, such a pure and delicate white, changes gradually next morning, as the sun comes up, to a light rose-pink, afterward becoming a deep pink; and the old blossom then closes, lies down, and falls off. Although these plants are found in the poorest of dry soil and rocky ledges, where they would seem to get no moisture, or very little, yet a lady friend who successfully transplanted them, says: "We planted them in the garden, bottom-land, along a creek, and there they grew larger and more beautiful, flowering freely until frost. On one plant of two years' growth I counted twenty or more buds." They have many seeds; seed-pod four-celled, about an inch long, fleshy at base and tapering up.

The absence of wild fruit or nut-bearing trees and shrubs is a noticeable drawback, but perhaps is not at all remarkable, the lands requiring irrigation for fruit or produce.

As far as the writer's observation extends, there is but one good fruit growing here: that is the red raspberry, in the mountains; large, hardy, and more finely flavored than the choice raspberries in the States.

I have been told of the buffalo-berry, but it can not be plenty or very choice, from accounts.

On the creeks there is a good gooseberry, and in low grounds the black- or choke-cherry; of these, native jellies are made; but ye highly favored, abundant-fruit people, can you imagine choke-cherries a luxury? Yea, verily, to us in desert-lands they are.

MASSAGE.

By Lady JOHN MANNERS.

IN the present day, when we hear so much of the wear and tear of daily work and worry, and when the preservation and restoration of health are of supreme importance to those who take the foremost rank in the battle of life, it may not be unprofitable to cast a glance on the means employed by the nations of the Orient and of antiquity to develop and maintain the vigor of the body.

The history of massage, which of late years has been employed with wonderful success as a cure for many ailments, has been written by Dr. Hünerfauth, of Homburg, and, in the hope that some hints may be useful, I have translated extracts from his comprehensive work.

The expression "massage" is derived, according to Pierry ("Dictionary of Medical Science"), from a Greek word signifying "to rub"; according to Savary ("Letters on Egypt"), its derivation is from the Arabic word "mass," to press softly. In England a process of somewhat the same character is known as shampooing. It seems certain that massage was practiced by the Indians and the Chinese many centuries before the birth of our Saviour. It was combined with hygienic gymnastics. The Brahmans exercised the art of healing; the priests of Buddha are known to have acquired much of their power over their people by their skill in medicine. Sir William Jones, the great Oriental linguist, discovered fragments of the third sacred book of the Brahman period, entitled "The Knowledge of Life," which contained many secrets of Indian medicine. An extract from Dally's work states that, when Alexander the Great penetrated as far as India, in the year 337 before Christ, his soldiers suffered much from the bites of serpents, for which no cure was known by the Greeks. Alexander had gathered round him the best Indian doctors, and he proclaimed to the army that any who had been bitten must come to the royal tent to be cured. These Indian doctors were in great repute; illnesses were not of frequent occurrence in those delightful climates, but any who were sick resorted to the wise men, or Brahmans, who cured them by wonderful or, as they professed, supernatural means. It has been ascertained that massage and shampooing were among the remedies employed by them.

The "Law of Manu" prescribed diet, washing, baths, rubbing, and anointing with oil as religious exercises.

In 1854 an account was published of a German merchant, who had been treated in Stockholm by medical gymnastics, and who made a journey to Calcutta, and went through a course of massage and exercises there, in order to become an authority on the subject. He afterward founded an athenæum for rational gymnastics in Berlin.

The gymnastic exercises of the Indians consist of (1) wrestling, (2) of what we should call boxing, (3) stick, or sword, exercise. They also practice movements for rendering the limbs supple, and manipulations of various sorts. Before the Indians begin their exercises, they cower on the earth, and by turns rub each other with the mud from the delta of the Ganges when they can obtain it. All the muscles of their bodies are pressed and kneaded. When Indians are unwell, they frequently employ a cure called *chamboning:* the whole of the patient's body is gently kneaded, beginning with the upper extremities, descending to the feet.

Dr. Stein, of Heidelberg, who spent some years in the Dutch medical service in Java, writes that massage is practiced there, as in almost all the Dutch colonies of the Indian Ocean. It is known as *pidjet-ten*, and it is also employed in the Society, Sandwich, Feejee, and Tonga Islands. Dr. Emerson, a native of the Sandwich Islands, says it is there called *lomi-lomi*, and is performed either over the whole or part of the body, usually by old women. It consists in rubbing and kneading, and may vary from the gentlest stroke to the most powerful grip. It is considered as a high mark of honor for a host to perform this operation for his guest, or to receive this attention from him. No pain is inflicted. Occasionally the natives lie flat on the earth, and let their children trample on them. In an account of the Isle of Tonga, it is related that, when people are suffering from great fatigue, three or four little children are employed to trample on the body of the patient as he lies on the grass. Massage is frequently applied to the forehead, or the top of the head, in those islands, with excellent results.

In Forster's account of Cook's travels in Tahiti, we read that the friendly inhabitants rubbed the travelers' limbs in order to refresh them after their fatigues.

The Chinese are supposed to have learned the use of gymnastic exercises from the Indians, and the subject was mentioned in the most ancient of their books, the "Cong-Fou," or "Science of Living." The Chinese added the use of medicinal plants to the treatment of illness by rubbing and gymnastic exercises. The Egyptians were and are proficients in the art of manipulation, anointing with oil and friction being part of the cure employed. The Greeks employed gymnastics and massage in order to preserve health as well as to restore it.

Pythagoras taught his disciples to practice moderation, to use vegetable diet and gymnastic exercises.

The gymnasiums and palæstriums of the Greeks were famous. Plato writes, "The object of gymnasiums is to instruct youths and men how to preserve health and keep their frames in good condition."

Before the Greeks took part in the national games, they had to undergo a course of preparation—bathing, friction, anointing, and also rubbing with sand. Fine sand from the Nile was preferred, and was imported from Egypt for the purpose; there were many rules for carrying out the process properly, and it was performed in various ways.

Among the many editions of the works of Hippocrates, there is a French one by Littré, in which the following passage occurs:

"A physician must possess experience of many subjects, among others, of massage."

Among the Romans, as, indeed, every child knows, the constant use of baths, followed by friction and anointing with oil, was customary. In illness, rubbing with warm oil, other kinds of friction, and "movement-cures," were used. Asclepiades also recommended exercise and friction. Celsus, the author of eight books on the science of healing, took for his motto, "The best medicine is to take no medicine." In inflammation of the brain, if he wished to induce sleep, he ordered rubbing for a considerable time (would this be animal magnetism?). He also advises rubbing to cure acute pains in the head, though not during an attack, and recommends friction to strengthen weak limbs.

Celsus lays much stress on passive movement for invalids. "The gentlest is exercise in voyaging on a ship, either in harbor or on a river. If being driven in a carriage is too fatiguing, he recommends the invalid to be carried on a couch or in a chair, and advises that the patient should be rocked in bed if too feeble to rise. Galen, who lived in the second century after Christ, approved highly of massage and gymnastics, but he did not advise athletics. He ordered friction in the evening, to remove fatigue. The body was to be rubbed with a woolen cloth, afterward with oil till the surface became red, and then with the bare hands in various directions. Rufus of Ephesus, who lived in the reign of Trajan, writes, "Women and maidens should sing and dance, not only to do honor to the gods, but in order to preserve their health." He adds, "It is important that physicians should not confine their attention to the bodily health, but should do all they can to develop the mental strength and well-being of children and young people, of men, and even of old men."

We must pass over notices of many treatises that appeared during the fifteenth and sixteenth centuries, only remarking that Hoffman, in 1708, seems to have advocated the principles that govern the German schools of gymnastics in the nineteenth century.

Hoffman wrote that the conditions under which health is to be

maintained are simple: exercise of various kinds, in alternation with rest, cold water, and strict attention to diet. One of his maxims was, that "work and tiring exercise are universal panaceas."

Between the years 1756 and 1786, Tronchin, a scholar of Boerhaave's, was in great repute in Paris; he was physician to the Duke of Orleans and to Voltaire, and it was owing to his advice that Voltaire went to live at Ferney. People came to consult him from distant countries; his success was extraordinary. His system consisted in ordering friction, movements of various characters, exercise, long walks, and certain precautions in diet.

Fuller wrote, about the same period, on the value of exercise in the cure of various illnesses, and especially in hypochondriacal and hysterical affections. He also laid great stress on riding; indeed, he established a riding-cure, which had great success among very distinguished persons. Tissot, of Lausanne, wrote a treatise on the health of the learned, strongly impressing on the studious and sedentary the duty of exercise; he advises games of billiards, ball, shuttlecock, hunting, shooting, swimming, wrestling, dancing, leaping, riding, walking, traveling, exercising the voice, speaking, reading aloud, declaiming, and singing. Here Dr. Hünerfauth remarks that many great physicians in old times considered reading aloud, declaiming, and singing highly beneficial to the general health. Plutarch mentions that daily exercise of the voice conduces greatly to health.

A system of gymnastics was established in Sweden by Peter Ling, between 1805 and 1839. He was the son of a pastor, and devoted his life to the study of exercises for the development of the human frame. Swedish exercises are much used now in England.

Massage and gymnastic exercises have more votaries in France than in England. The love of sport that seems inherent in English people is supposed to have obviated the necessity for a widely extended system of gymnastics. Now, however, gymnastic exercises and musical drill are being introduced largely, and have been much appreciated, not only by men and boys, but by women and girls.

The system of massage practiced by Dr. Metzger has drawn crowds to Amsterdam, and has afforded relief to great numbers of sufferers, several reigning sovereigns—among others the Empress of Austria—being among his patients. Dr. Hünerfauth carries out the same system at Homburg with equal success, and a member of his family devotes much of her time to relieving from charity the sufferings of the peasants.

It is necessary to beware of masseurs who have no real knowledge of the art, as disastrous results follow from the violent treatment to which ignorant persons subject their patients. Dr. Hünerfauth deprecates massage by machinery, as he considers that much delicacy is necessary in treating the complicated nervous system of the human frame. It is curious to find how much benefit many sufferers derive

from a revival of the same remedies practiced in by-gone ages and in distant climes. Truly, there is nothing new under the sun.

It has occurred to me that women might, after being properly instructed, find the practice of massage a useful and profitable employment. I believe the usual time employed at one sitting is from twenty minutes to half an hour. To relieve, for instance, the oppression produced by irregularity of the action of the heart, gentle continuous rubbing would be practiced for ten minutes from the left to the right side in a downward direction, then from right to left. The patient should lie on a reclining board, and the masseuse stand so as to be able to rub firmly, though without inflicting the least pain. To calm nervous agitation and to induce sleep, it has been found that rubbing the spine is an almost certain remedy, and sufferers from neuralgia have often derived great benefit from massage.

Friction with pine-oil is a favorite cure for rheumatic affections in Germany, and also for bronchial and throat complaints. The aromatic, astringent fragrance of the oil, which is made from resinous portions of the fir-trees, has a salutary effect in pulmonary cases.

I happened lately to read an account of an institute in London whence "masseurs" are sent to private houses. I know nothing of the system carried out there, but I see that four guineas a week is the charge for daily visits at the patient's own house.

Such an expense would be out of the question for most people, as a course of massage should be continued for six weeks or two months. Indeed, there are many invalids, of great position and wealth, who have a masseuse attached to their households. Doubtless there are numbers of women who would gladly practice this healing art for moderate remuneration, and find much happiness in soothing pain and relieving weariness.—*Nineteenth Century.*

SKETCH OF CHARLES C. ABBOTT.

THE name of Dr. Abbott is familiar to the readers of the "Monthly" as that of the author of papers showing him to be on the best of terms with Nature, as well as of an archæologist who finds history where ordinary diggers would find only gravel and river-shells. It is as well known to readers of other periodicals in America and England, who are interested in the moving and the blooming life of the fields and the woods and the rivers. He has been making friends by means of his charming sketches, and the books that have resulted from them, till he now probably numbers all of the English-speaking world, who appreciate rural things, among his constituency. What remained wanting to fix his fame and make it general was given by his last book,

"Upland and Meadow," of which the English critic, James Purves, pronouncing it "the most delightful book of its kind which America has given us," and declaring that "it closely approaches White's 'Selborne,'" only gave formal expression to the thought which arose in the mind of every reader.

CHARLES CONRAD ABBOTT was born June 4, 1843, in Trenton, New Jersey, the third son of Timothy Abbott and Susan Conrad. He is of Quaker descent on both sides. His paternal ancestor came from England in 1680, and his maternal ancestor, Dennis Conrad, the founder of Germantown, Pennsylvania, from Germany at about the same time.

Until nearly the present time the family (Abbotts) remained Quakers, in three generations only two marriages with others than Quakers having taken place. Dr. Abbott's own sympathies are with the Hicksite or Unitarian branch of that denomination.

Although no naturalist among the Abbotts of Burlington County, New Jersey, appeared in earlier generations, it is a somewhat significant fact that a fondness for such studies was so marked as to lead to a long intimacy with the Bartrams of Philadelphia, when the naturalists John and William (father and son) were living, and the celebrated Bartram's garden on the Schuylkill was kept up.

Young Abbott himself exhibited a very strong liking for natural history at an early age, and never was afraid of living animals of any kind. This fearlessness resulted frequently in stings, bites, and scratches by the creatures which, too often, were rudely handled. These tastes were probably an inherited trait, derived from his maternal grandfather, Solomon W. Conrad, at one time lecturer on botany and mineralogy at the University of Pennsylvania.

From 1852 to 1858, inclusive, Abbott attended the Trenton Academy, then a good classical school, but under strict theological control, where anything savoring of science, even zoölogy, was frowned upon as likely to produce direful spiritual results. Indeed, Abbott was once punished for asserting that a whale was not a fish, the teacher insisting that it was, "on the authority of Scripture." Rebellion against such ignorance kept Abbott in ill-favor with the faculty, and practically little knowledge worth the having was acquired. But, as an offset to this, every Saturday and Sunday was wholly taken up with out-door studies of the fauna of the neighborhood. The gatherings of these "two-day" tramps were usually brought home alive, and the frequent escape of snakes, lizards, and snapping-turtles, not only in the yard, but in the house, necessitated some restrictions upon his methods of study, which, however, were usually circumvented, and the obnoxious creatures kept turning up in many unsuspected localities.

When, on the approach of manhood, the vital question of business or a profession came up, the nearest approach to Abbott's tastes was the study of medicine, and it was commenced in a half-hearted way

in 1860. The choice of a preceptor was more happy in a zoölogical than in a medical point of view, and the result was that teacher and student were "two boys together," discussing the woods and meadows rather more assiduously than human anatomy.

Often, in fact, text-books were laid aside for months, to give undivided attention to the fauna of the Delaware River Valley. The wide-reaching meadows, tangled swamps, and stretches of woodland on his grandfather's farm formed, collectively, the college from which it was Abbott's ambition to graduate.

The result of this untrained field-work, during 1860–'63 was a series of papers on the habits of mammals, birds, batrachians, and fishes, which were presented to a learned society for publication, and rejected, on the ground of the improbability of a *boy* having been able to discover so much that was not already in the writings of authors, and also because some of the observations were in many ways contradictory of them.

Young Abbott's career as an author began in 1859 with a note concerning migratory birds, which was published in the "State Gazette," of Trenton, as his maiden effort. This was followed by a short series of ornithological sketches in the same paper. In 1860 he published brief communications on fishes in the "Proceedings" of the Academy of Natural Sciences of Philadelphia, and an account of the habits of the curious pirate perch (*Aphrodederus sayanus*).

The manuscripts of the rejected papers were preserved, and, in subsequent years, the later generation of naturalists verified, in their field-work, the results claimed to have been obtained by Abbott. Without detracting from the credit which is justly due to them as independent observers and discoverers, it is proper to say that Abbott would have forestalled much of recent work in the study of the habits of animals had his papers, when presented, been accepted.

In 1865 Abbott was graduated in the medical department of the University of Pennsylvania. He was married in 1867, and from that time, except for a brief interval, when engaged in manufacturing chemicals, he has devoted himself to scientific study and general literature. In 1874 he came into possession of the Abbott homestead, and was thus better enabled than before to prosecute his studies, in the pursuit of which he has spent days and nights also in the field, and has thus enjoyed the opportunity of studying the objects of his inquiries in all the situations and aspects of their life; and then it was that, more systematically than ever, he undertook those exhaustive archæological investigations which have been so fruitful of results, and have associated him so closely with the Peabody Museum of Archæology at Cambridge, Massachusetts, of which institution he has been an "assistant in the field" since 1875.

The fullness and value of Dr. Abbott's work in science can best be realized by glancing at the essays and reports which he has published.

Omitting purely literary productions, these cover one hundred and seventeen titles.

In the "American Naturalist," commencing with Vol. IV, 1870, to Vol. XIX, inclusive thereof, will be found contributions by him under forty-nine titles, covering 228 pages.

Twenty-two of these papers are leading articles; the others are "notes." They are all either archæological or zoölogical. The former, twenty-five in number, include the first communications by him, on the occurrence of palæolithic man in the valley of the Delaware River; and the article, on "The Stone Age in New Jersey," which was the basis from which his more elaborate works to be hereafter mentioned were developed.

Twenty-seven articles or notes in the "Naturalist" are zoölogical, and twenty-five of them treat of birds or fishes of New Jersey; of the other two, one is on the "Habits of Cray-fish," and the other is on "Winged Ants."

The most important zoölogical paper of this series is that on "Traces of a Voice in Fishes." In this article, Dr. Abbott aims to show that a relationship between color and voice obtains among our fresh-water fishes; that brightly colored fishes are diurnal in habits and attract the *eye* of the opposite sex, in the breeding-season; but dull-colored fishes are nocturnal, and the sexes are attracted by the *ear*. Studies in the tropics of marine fishes tend to confirm this view.

He has contributed to the English journal, "Science Gossip," beginning in 1872, first under the editorship of M. C. Cooke, and afterward of Dr. John E. Taylor, twenty articles, of which eighteen were illustrated.

In "Science," Vols. I to VI, both inclusive, are seventeen communications, eight of which are leading articles. Those on the "Intelligence of Fishes," and supposed "Æstivation of Mammals," have attracted much attention. In the articles on "Hibernation," Abbott aims to show that, in so fluctuating or uncertain a climate as in New Jersey, hibernation is not so fixed a habit as has been supposed, and is "optional" with many mammals; they hibernating when cut off from food-supplies, and so avoiding starvation. Intelligence appears to play a prominent part in this series of articles, for, besides the "Intelligence of Fishes," already mentioned, we find among them papers on the "Intelligence of the Crow"; of "Birds"; of "Batrachians"; and of "Snakes"; and one on "Color-Sense in Fishes." The archæological articles relate the occurrence of amber near Trenton, New Jersey, and of mound-builders' pipes in New Jersey; and concern "Palæolithic Man in Ohio," "Evidences of Glacial Man," and "Eastern and Western Indian Implements."

To "Nature" he contributed, in 1872, "American Flint Arrow-Heads," "Origin of American Indians," and "Feeding Habits of the

Belted Kingfisher"; in 1875, "American Stone Implements," "Habits of the Kingfisher," "Occurrence of Flint Scalping-Knives in New Jersey," "Supposed Marriage Emblem of American Indian Origin," "Iron Axes from West Virginia," and "Stone Masks from New Jersey"; in 1876, "American Stone Tubes and Tobacco-Pipes," and "American Flint Skin-scrapers"; and, in 1883, a note on the origin of the American dipper's power of diving and aquatic habits, being a reply to the Duke of Argyll's objections to an evolutionary view of the origin.

Of eight contributions to "Science News," which was published by Ernest Ingersoll and W. C. Wyckoff, in 1878 and 1879, one entitled "Do Opossums play 'Possum?" is noticeable because it is an endeavor to show that the animal when attacked or captured is overcome by fear, and does not designedly simulate death; and develops the view which was subsequently published by Romanes as entertained by Darwin in his posthumous essay on "Instinct," which was printed by Romanes, in his "Mental Evolution in Animals." Abbott's independent conclusion as expressed in this paper was published four years prior to the appearance of Romanes's book or of Darwin's essay.

In "The Popular Science Monthly" he has published papers on "Certain Phases of Bird-Life," "Birds' Nests," the "American Chipmunk," "To what Extent is Evolution visible?" "An Inscribed Indian Tablet," "Migration of Inland Birds," "Traces of a pre-Indian People," "The Nest and Eggs of the Thistle-Bird," "Some Rambles of a Naturalist," "Archæological Frauds," and "Animal Weather-Lore." Among his contributions to other volumes are the "Report on Fishes of the Delaware River," and "Winter Habits of Fishes of the Delaware River," in the United States Fish Commissioner's Report for 1875–'76; "Catalogue of Vertebrate Animals of New Jersey," in the State Geological Report for 1868; "Palæolithic Man in America," in Kingsley's "Standard Natural History"; "The Stone Age in New Jersey," in the Smithsonian Annual Report for 1875; papers on Chipped Stone Implements, Stone Mortars and Pestles, Cooking Vessels, Wood Implements, Pipes, Sculptures, Bone Weapons, etc., in Wheeler's "Report upon United States Geographical Surveys west of the One Hundredth Meridian"; on "The Discovery of Supposed Palæolithic Implements from the Glacial Drift in the Valley of the Delaware River," near Trenton, New Jersey, in the "Reports of the Peabody Museum of American Archæology and Ethnology," for 1876 and 1878; "An Historic Account of Discoveries of Palæolithic Implements in the Trenton Gravels," in the "Proceedings" of the Boston Society of Natural History for 1881, and of the "Discovery of Human Remains in the same Gravel," in the "Proceedings" for 1883.

Also, from time to time he contributed to young people's magazines, such as the "Riverside" and "St. Nicholas," and more recently to

weekly papers of the higher class, articles of popular zoölogical character. In 1883, Dr. Brinton, of Philadelphia, read a paper on "Palæolithic Implements," by Dr. Abbott, at the meeting of the Congress des Americanistes, in Copenhagen.

In 1881, Dr. Abbott published his first volume, "Primitive Industry, or Illustrations of the Handiwork in Stone, Bone, and Clay, of the Native Races of the Northern Atlantic Seaboard of America." Pp. 560. Illustrations 426. George A. Bates, Salem, Massachusetts.

The work may be said to be the natural outcome of the fact that the author lives in a neighborhood once densely populated by the Indians; but its appearance was also expedited, if not occasioned, by the encouragement which he received from the Peabody Museum, at Cambridge, in prosecuting an exhaustive search for traces of man in the valley of the Delaware.

The collection of stone implements made by Dr. Abbott in New Jersey was placed, years ago, in the Peabody Museum at Cambridge, and has since been added to yearly, until now fully twenty thousand specimens are on exhibition. It has recently been said of it in "Science," that it "is one of the most important series of the kind ever brought together, and one which archæologists will consult for all time to come."

The volume is composed really of three parts; and the aim of the author is to show that, during the close of the Glacial Epoch, if not earlier, man, associated with arctic mammals, occupied the valley of the river; this being indicated by the occurrence *in* the gravels of stone implements alike in character with the palæolithic implements of Europe, but made of dense argillite, instead of flint; later, as attested by a class of better finished objects made of argillite, and as a class found under circumstances indicating antiquity greater than the ordinary surface-found Indian relic; lastly, the ordinary jasper and quartz arrow-heads and sandstone axes of the Indians proper.

Since the publication of the book, a vast deal of material has been gathered, and the result has been to confirm the views expressed in the volume. A fragment of a human cranium, a lower jaw, a tooth, and lately a fragment of a human temporal bone, have been taken from the implement-bearing gravels. A critical reviewer, in the "Nation," has said of the volume: "It is a valuable addition to the sum of our knowledge of aboriginal man; . . . as such, it is abundantly worthy of a place beside Mr. Evan's elaborate treatise on the 'Ancient Stone Implements of Great Britain.'"

In 1884 was published "A Naturalist's Rambles about Home" by D. Appleton & Co., New York. It is a selection, in part, from many contributions to zoölogical journals, but also contains much original matter. It is exclusively "field" studies, and results of daily observations of the animal life about the author's home.

In February, 1886, Harper & Brothers, of New York, published "Upland and Meadow," a volume on the same general style as the preceding, but in no instance repeating the subject-matter of the earlier volume. The two books give a nearly complete account of the fauna of a New Jersey farm; an account which will be really completed by the publication of a third volume, treating largely of botanical features.

An idea of the quality of Dr. Abbott's books—the true flavor can be enjoyed in its perfection only in reading the books themselves—is given in the London "Academy's" (May 1, 1886) notice of "Upland and Meadow," which concludes:

"Books like this make us more interested in America than do the countless volumes of travelers. There is that charm of freshness, that power of interesting us, as much as the writer was himself interested, that frank inquisitiveness—though it may smack a little of the modern interviewer, carried to the world of upland, meadow, river, and trees, taking stealthy views at the midnight side of Nature with a dark-lantern—which make the book attractive from beginning to end, which make us read every page, and make it, by our keeping it as a book of reference, memorable. It abounds not only in facts, but in fancy; and so a boy from school or a world-wise father will find that it adds to his joys in the open air, or reveals the wonderful life about his feet."

Dr. Abbott is a corresponding member of the Boston Society of Natural History; of the New York Academy of Sciences; of the Linnæan Society of New York; of the Nuttall Ornithological Club of Cambridge, Massachusetts; of the Anthropological Society of Washington, D. C.; of the Numismatic and Antiquarian Society of Philadelphia; and of the Davenport Academy of Sciences, Davenport, Iowa; and is a Fellow of the Royal Society of Antiquaries of the North, Copenhagen.

CORRESPONDENCE.

"THE JOINT-SNAKE IDIOCY."

Messrs. Editors:

IN "The Popular Science Monthly" for December, 1886, Dr. Felix L. Oswald, in discussing "Zoölogical Superstitions," speaks incidentally of the "joint-snake." He says:

"The joint-snake idiocy, on the other hand, though knocked to pieces a hundred times, persists in reviving with symbolic promptitude. In the Rocky Mountains, on the lower Mississippi, and all through the southern Alleghanies, farmers and hunters still believe in the self-reconstructive power of a reptile that survives dismemberment, with the facility of a New York tramway ring, and, after picking up a jaw-bone here and a couple of vertebræ there, pursues its way rejoicing, and ready to segregate again at a minute's notice."

This sneer is the "last straw" which prompts me to relate, for the first time in public, what I know of the joint-snake. I have seen three specimens, all in their native haunts, and all in the meadows of a farm on which I lived but two years of my life. Hence I know that it was within that period that I saw all three of them. It was during the last years of the war.

I saw them at different times and in different places, but no two of the places, I should say, were more than fifty rods apart. I could very nearly locate all three of the places now. I distinctly remember the direction each snake was going, the direction it was from me, the order in which I saw them, and what occurred at each observation. I shall briefly relate the circumstances of each case, and the observations made.

The first was in haying-time. In gathering up a forkful of hay to "top out" a wagon-load, which was just ready to start for the barn, I discovered a snake of a kind I had never before seen. It was not a large snake. I should say it was about the size of the average garter-snake—say, twenty inches long. It was also shaped very like a garter-snake. Its head was noticeably small, and inclined to be square built. It was the most innocent-looking serpent I had ever seen. It was longitudinally striped, of a dull-white and a pretty and decided gray.

It did not "fly to pieces" when I touched it. I did not strike it hard. The first hint I had that I had caught the far-famed joint-snake was when I saw it lying before me in several joints—I should say five, six, or seven. I then made no further effort to kill it. I bent over it, in the broad daylight of high noon, and carefully examined its parts, in spite of the repeated urgent appeals of my brother to hurry off to the barn with the load of hay, as it was nearly dinner-time.

The joints were quite regular in length, and three or four inches long, the head and tail joints being somewhat the shorter. Each joint had at its front end five fleshy processes, shaped very like a necked strawberry, and apparently fitting into five holes in the rear end of the next anterior joint. The processes were pointed in front, and reached their greatest thickness about a good tenth or an eighth of an inch from their attachment to the joint. I distinctly saw and counted the processes, and also the holes into which I supposed they had fitted. It was a neat piece of dove-tailing.

I put one of the pieces into my pocket, to carry home and save as a curiosity. Then it occurred to me that after all the main point was to see whether the joints would come together again and that the loss of one of its joints might defeat it. So I laid my selected joint down again with the rest, and, carefully marking the spot, went to dinner. That over, I returned to the field and to the marked spot; but no snake of any kind was there.

The second time was in another field, also at haying-time, probably a year later. This time I recognized an old acquaintance, and cut him in two about the middle with my scythe. This was also at noon on a bright day, and before going to dinner I laid down my scythe so as to mark the spot. And again, when I returned, there was no snake. I saw him divide into pieces, and saw that I had cut one of the joints in two about the middle. As in the first case, the joints were regular in length and shape, and the connections were the same. The proportion of length of joint to length of snake was also the same. I touched the snake in only one place. I let him crawl across my scythe-blade until his middle was on the edge, and then I set my shoe-sole on him and the sharp edge neatly and quickly cut him in two. Then he went to pieces all the way along, and I left him lying untouched.

The third time was in another field adjoining that one, and at a different time of the year, on a cloudy day. This time I was older, and quite interested. I could easily have killed him, had he been any kind of a serpent of his size. But this time I was at leisure, and determined to give my old friend a very thorough examination. So I looked

about for a stick long enough to lay gently upon him without danger of being bitten. Meantime he looked about for a hole in the ground, which he was fortunate enough to find before I found a suitable stick. I saw him glide into the vertical hole, and I have seldom parted with a friend more sadly. I still hope some day to go back to that farm and find and keep a real joint-snake. I have never seen one elsewhere.

Ever since that day I have sought in books a fair description of my friend, but in vain. He is called a "glass snake," his breaking to pieces is ill-described, his coming together denied, and he is made the butt of ridicule, as in the above extract. In his behalf I can only testify that he goes to pieces, of regular lengths, by an easy motion, the cleavage occurring at points where he is not touched, and the joints having an admirable arrangement for reconstruction. I always supposed it was a defensive provision, a "'possuming" process, to deceive the enemy into the belief that his victim was dead, when in fact he was not. Before I had seen one, I used to reason with my school-fellows as to the possibility of joints in the intestines. I now see that the first joint would suffice for the intestines. The cutting off and reopening of channels for the circulation of the blood offer no difficulty.

I never based any positive conclusion on the disappearance of the two specimens which I saw dismembered. I always considered the easy possibility of their having been devoured by large birds. There were no domestic animals in either case to disturb them.

The puzzling question to me is, what possible object has Nature or Divinity in jointing that snake, if his going to pieces, which I know to be at least semi-voluntary, is the end of him? Pending an answer, I shall believe him capable of reconstruction. I was never in the slightest degree superstitious in such matters, and was always skeptical about the joint-snake until I saw it and examined it. I have been very careful not to relate anything more than I actually saw. I was between thirteen and sixteen years old at all these times. I am under the impression that I was fourteen years old when I saw the first specimen.

The farm was in Des Moines County, Iowa, about eight miles west of Burlington, and lay across the Chicago, Burlington and Quincy Railroad.

HENRY J. PHILPOTT.

DES MOINES, IOWA, *December* 1, 1886.

EDITOR'S TABLE.

PROPHETS OF EVIL.

IT is remarkable how many able writers are devoting themselves now-a-days to proving that, under the influence of the scientific and philosophical theories most in vogue, modern society is rushing to destruction. It is also remarkable that, in spite of the clearness with which they discern the danger, not one of them comes forward with a single practical suggestion as to how it may be averted. Last year we had a novel from the pen of a leading French Academician, M. Octave Feuillet, the special object of which was to show how particularly destructive the doctrines of Darwin were to female virtue. The leading character, a certain freethinking and free-living viscount, marries an extremely estimable and rigidly orthodox lady, to whom at the time he is sincerely attached, but whose marked aversion to fashionable follies becomes in the course of time a weariness to him. He then falls in with a young lady who had been brought up by a scientific uncle in complete emancipation from all theological dogmas. This young woman, perceiving that the viscount has conceived a foolish passion for her, and would probably marry her were there no obstacle in the way, seizes a favorable opportunity of poisoning his wife. The plan succeeds perfectly, and the viscount finds himself now with a wife who is prepared to plunge with him into all excesses of gayety and frivolity. He finds, too, that he is not himself more completely emancipated from all severe notions of domestic virtue than is the lady to whom he has given his name and his title. In a word, the pace at which this interesting creature wants to go is as much too fast for him as the pace at which he was going a few years earlier was too fast for his first

wife, the gentle "Aliette." The latter had left him one child, a daughter; and retiring to the country for a few days to visit this child, he learns from an old servant, then on her death-bed, the whole story of the poisoning of his first wife by the woman whom he had made his second. He learned, also, that the thing had been so managed as to make him appear, in the eyes of the dying Aliette, an accomplice in the horrible crime. Conscience-stricken and overwhelmed with remorse, he rushes to Paris and succeeds in banishing the murderess from society and from the country. He himself shortly after dies broken-hearted, but not before he has abandoned his worldly philosophy and embraced the religion of "Aliette"—Roman Catholicism. Such is the narrative as constructed from the inner consciousness of M. Octave Feuillet. The moral is obvious—that the Roman Catholic faith is the only bulwark against immorality and the disintegration of society. Substantially the same lesson is that which Mr. Mallock has been trying to teach, and which Mr. W. S. Lilly enforces in his recent "Fortnightly Review" article on "Materialism and Morality."

Now, it strikes us that all this momentarily fashionable writing is conceived in a very idle strain. What the world wants is not a succession of jeremiads over the effects likely to be produced by the prevalence of certain opinions, but a demonstration of the truth in regard to those opinions. If the theories of Darwin are false, let their falsity be exhibited. If Mr. Spencer's wider scheme of evolution is illusive, let its illusiveness be proved. The press is as free for the opponents of these great thinkers as for their adherents. The platform is open to them; the pulpit as yet is theirs almost exclusively. They can have nothing, therefore, to complain of as to the conditions of the controversy; and yet in all their utterances we may detect a certain note of dissatisfaction, as if, somehow or other, the verdict were unjustly going against them. The verdict, however, will follow the evidence; and the world will not accept as evidence against a scientific theory the mere assertion that its moral effects are injurious. That assertion itself would have to be proved far otherwise than through the easily constructed mechanism of a novel with its puppet figures moving hither and thither at the will of the manipulator. To the earnest mind of the old Roman poet Lucretius the free, untrammeled study of Nature was the chief preservative against evil thoughts and practices; and how easy it would be for a skillful writer, adopting this hypothesis, to write a novel in which all the conditions and consequences of M. Feuillet's narrative would be reversed! No, there is no argument in this kind of thing. Evolution, as a system of thought, has not gained ground by the aid of the novelist, and it is not going to succumb to a novelist's attacks. It has gained ground because it has explained many things previously inexplicable and has shed light into every department of Nature and of thought. It can not, therefore, be dispossessed of the ground it has gained till a stronger than it appears, some view or theory that will explain more things than it can explain, and shed more light upon the problems of existence than it can shed. The whole question lies here in a nutshell. The thinking world is not fatally or irrevocably bound to the formulæ of Darwin and Spencer; it adheres to them only for the service they render, and is prepared to lay them aside so soon as any superior generalizations are brought forward.

Supposing, however, that we admit that the moral results of the introduction of the new philosophy are not satisfactory; supposing it to be true that men, in their new-found liberty from certain external sanctions, are showing a great want of self-control and an indifference to all moral aims—what are

we to conclude? Simply this, that the moral education of the race so far has been lamentably defective, that it has not sufficed to bring the lower impulses under subjection to the higher, that it has not taught the love of virtue for its own sake, that it has left men enslaved to purely personal hopes and fears and without any conception of the larger life in society—a life regulated by justice and sweetened by good-will—which is really attainable in greater or less degree by every normally constituted human individual. The evolution philosophy is, in a certain sense, a *régime* of freedom; and if a certain society, at a certain date, is found to be unfitted for it, we conclude, not that the *régime* of freedom is bad in itself, but that the society is backward and undeveloped. It is no condemnation of parliamentary institutions to say that they are not suited to Caffres or Malays. If it should be said that the doctrine of evolution is as much unsuited even to the most advanced societies of to-day as parliamentary institutions are to Caffres or Malays, we might reply, "The more's the pity, seeing the doctrine has come into the world, and has apparently come to stay." We should prefer, however, to traverse the assertion, and to say that the ready acceptance which is being given to the doctrine is primary evidence of its being suited to the needs of at least a large section of the community. Some may take it and abuse it, as they would any other doctrine, converting it, as certain sectaries a couple of centuries ago did the Christian doctrine of justification by faith, into a scheme of antinomianism. But this does not do away with the fact that the doctrine has an intellectual attraction for nearly all the more advanced minds, and that these therefore may reasonably be supposed to have some power of adapting themselves to it. In all periods of transition allowance must be made for the disorders incident to the unsettlement of men's minds. At the period of the Reformation these disorders were of the most alarming kind—far more alarming than anything we have to contemplate at the present moment. The duty of the hour, therefore, for those who accept the new ideas, is to face whatever may be the difficulties of the situation boldly, and to apply themselves to developing and demonstrating all the useful truths that are deducible from the theory of evolution. The time has come to throw upon men in a distinct and emphatic manner the full responsibility for their own actions. Heretofore the teaching has been that unless men held to certain special doctrines and theories, they could not be expected to live pure or righteous lives; and under this teaching much moral weakness has been engendered. To-day it is in order to proclaim to one and all that they must settle their opinions with themselves; but that, whatever they may *think*, there is only one line of *conduct* that befits a man born into a civilized society, and that is a conduct marked by self-restraint, and a care for the good of the whole social organism. The prophets of evil are doing evil, and that continually. They are helping on that relaxation of morality which they deplore, seeing that they deny all moral authority to principles not founded on their own special dogmas. There is great need of an organized effort to antagonize the mischievous effect of their writings by preaching hope where they preach despair, and the progress of humanity through increasing knowledge where they announce the dissolution of all social bonds through the advent of a philosophy which has the misfortune of not being theirs.

A STRANGE SIGHT IN SOUTH AFRICA.

EVERYBODY nearly has been reading that wonderful tale of imaginary adventures, "King Solomon's Mines"; but perhaps not very many have noted the most startling and extraordinary fact recorded in it, one in comparison

with which all the other marvels recorded are the merest commonplace. The gifted narrator tells us how, shortly after the sun had sunk in the west, there came a glow in the east, and presently "the crescent moon peeps above the plain and shoots its gleaming arrows far and wide." What do our astronomers say to this—the crescent moon rising in the east shortly after sunset? It won't do, Mr. H. Rider Haggard! We will believe your elephant stories, if you like, follow you into ghostly caves, and accept with a reasonable discount what else you tell us that is remarkable; but we don't believe that in South Africa, or anywhere else on this planet, the crescent moon rises in the east shortly after sunset. It can't be done as the solar system is arranged, and you should have left that out. Speaking seriously, it does seem extraordinary that a man who all his life has seen the crescent moon setting in the west shortly after the sun, should, even for a moment, imagine that he could see it rising in the east at the same time of day. Tom Hood has described a somewhat similar case for us in his "Love and Lunacy," where "Ellen" drives her astronomer-lover distracted by announcing that the moon is at the full, and that she is thinking of him; the fact being that the moon had been full just three weeks before, and that the object she took for the full moon was "the new illuminated clock." Of poor "Ellen" Hood tells us that—

> "As often happens when girls leave their college,
> She had done nothing but grow out of knowledge."

But here we have the same thing over again fifty years later, and on the part of a really clever writer; the only difference being, that whereas "Ellen" saw the full moon (or said she did) at a date when it was not to be seen, Mr. Haggard affirms that he saw the "crescent moon" rising about the hour when, if visible at all, it must really have been setting. Popular education has been advancing during these fifty years; but it is still, we fear, the exception for people to be taught to interest themselves in even the more important phenomena of the physical world. If it could once be realized to how large an extent the intelligence of the community must depend upon the assimilation of true scientific knowledge, and how increasingly important it is becoming from year to year that the public mind should be fortified by intelligence against ill-digested and revolutionary theories, we believe a new impetus would be given to scientific instruction everywhere. We do not wish to make too much of the careless blunder into which the author of "Solomon's Mines" has fallen; but, seeing that such blunders are possible in such a quarter, teachers might well take some special pains to draw attention to the facts in this simple matter. Here, we may say in conclusion, a book like Miss Bowen's "Astronomy by Observation" is an excellent guide. As its title partly indicates, it summons the student to a close personal observation of the movements of the heavenly bodies, and thus brings the facts home to him more vividly than could be done by any amount of purely theoretical dissertation.

LITERARY NOTICES.

HISTORY OF THE PACIFIC STATES OF NORTH AMERICA. By HUBERT HOWE BANCROFT. Vol. XXIV. Oregon, Vol. I. San Francisco: The History Company. Pp. 789.

THE more remote events in Oregon affairs have already been given in the "History of the Northwest Coast." The later volumes, to which this one belongs, deal with events that occurred within the memory of men now living. They have been wrought out from original sources, and contain a large proportion of facts which have never before appeared in print. The author has found it more difficult to treat fully and fairly this comparatively modern epoch, from crude material, than earlier ones which had been worked over by scholars. Of hundreds of

personal narratives used in making the history, no two wholly agree; "and yet, to the careful student, with all the evidence before him, the truth is generally clear." The leading features of the history of Oregon, Mr. Bancroft points out, are not the pursuit of conquest, but commercial enterprise and agricultural industry, "the Fur Company, the missionaries of different sects soon converted into rival traders, and the middle class from the United States, all contributing of their several characteristics to form a society at once individual and independent. It is in the missionary, rather than in the commercial or agricultural elements, that I find that romance which underlies all human endeavor before it becomes of interest sufficient for permanent preservation in the memory of mankind. A mountain-walled plain, between the coast elevations and the northern stretch of the great Andean range, with a fertile soil, a genial climate, and picturesque scenery, through a peculiar sequence of events, becomes the Western Utopia of the American States, and kindles in the breasts of those who here lay the foundations of a commonwealth the fire of patriotism, forever sacred even when fed by fallacies. The silent conquest of this area by men and women from the border, intent on empire, is a turning-point in the destinies of the country; and it is to me no less a pleasure than a duty to recognize the heroic in this conquest, and to present one more example of the behavior of the Anglo-Saxon race under the influence of American institutions." We find these remarks to a considerable extent verified as we turn over the chapters devoted to the history of the missions, which are replete with personal adventure, and varied with incidents that might serve as the framework of many romances. Mr. Bancroft is disposed to take an optimistic view, which is nearly peculiar to the frontier, of the fate of the Indians, of which he says that, "aside from the somewhat antiquated sentiments of eternal justice and the rights of men as apart from man's power to enforce his rights, the quick extermination of the aborigines may be regarded as a blessing both to the red race and to the white. . . . And this happy consummation—the swift and sharpest means of sweeping from the earth every human incumbrance—the people of the United States have never been backward about. . . . Avarice, injustice, and inhumanity are often the most important aids to civilization. In this respect, with noble intentions and devout aspirations far higher than ordinary, the settlers of Oregon but followed their destiny. They labored for the best, and quarreled not with the inevitable." The story in the present volume begins with the application of the Flathead Indians to Mr. Clarke, Indian agent at St. Louis, in 1832, for religious men to be sent "to point their people the way to heaven," and is continued till the erection of a territorial government in 1848.

A Treatise on the Practice of Medicine. By Roberts Bartholow. Sixth edition, revised and enlarged. New York: D. Appleton & Co. Pp. 990. Price, $5.

The first edition of this book appeared in 1880, as a companion volume to the author's already published work on "Materia Medica and Therapeutics." The edition of three thousand copies was exhausted in less than a month, anticipating the judgments of the numerous medical journals of the country, and a new edition was called for, in which the text was revised and two articles of importance were added. Evidence of continued giving of satisfaction to the needs of many readers appeared in the steady, rapid sale of the work, and a third edition appeared in 1882, again revised, and with fifty pages added. A fifth edition followed close upon a fourth, in the spring of 1883, and in it the *bacillus tuberculosis* was noticed, and the increase of minute organisms in pathogenic importance was recognized. The book itself, in the beginning, was undertaken while the author was Professor of the Theory and Practice of Medicine and of Clinical Medicine in the Medical College of Ohio, on the urgency of students and practitioners who attended his lectures, and of many readers of his therapeutical treatise. The author was more inclined to the work, because the subject was one to which he had devoted all the years of his professional life, and under the most varied conditions, of army service before and during the rebellion, and an extensive practice of sixteen years at Cincinnati. With one or two exceptions, he has had personal

charge of the maladies treated of in the work, and has made them the subject of clinical demonstration or *post-mortem* investigation. In preparing the present edition, he has sought to make it still more worthy the approbation of his readers as the most certain method by increasing its practical resources. While not overlooking the advances made in scientific medicine, he has devoted most attention to the clinical aspects of the subject; but with the effort to preserve due harmony and proportion. Some new subjects have been introduced, and preliminary chapters have been appended to the chief divisions of the work, to make the study of the diseases of the class more exact, and to enhance the practical character of the whole; and the author hopes that little properly pertaining to the domain of practice has been overlooked, and nothing superfluous has been added.

STUDIES IN ANCIENT HISTORY, COMPRISING A REPRINT OF "PRIMITIVE MARRIAGE." By the late JOHN FERGUSON MCLENNAN. A new edition. London and New York: Macmillan & Co. Pp. 387. Price, $4.

THE "Primitive Marriage," or "Inquiry into the Origin of the Form of Capture in Marriage Ceremonies," although confessedly only a tentative investigation, or, as the author phrased it, "an exercise in scientific history," made its mark at once when it first appeared, and has held a foremost place among works of original research for twenty years. Although republished twice within that period, it has been given both times unaltered: the first time because the author had been prevented from superseding it by the more comprehensive work he had intended, while, in the presence of the earnest demand for it, with or without revision, it was considered "better that it should be made accessible to students with its imperfections, than that it should remain inaccessible to them"; and the second time, in the present edition, as a posthumous work, for which the same demand was still current. It is, however, followed up with a second volume containing other writings of the author, "from which it will be possible to gather, in a considerable measure at least, how far the author's views had grown or been developed, how far they had changed or been added to, subsequently to the appearance of "Primitive Marriage." A few notes are given, which are confined to certain matters on which the author had announced a change of view, and to some other matters, such as Mr. Lewis H. Morgan's speculations, where circumstances had made an additional statement imperative. In an appendix to "Primitive Marriage" is given a pretty full collection of examples of the form of capture, upon the basis of a collection which the author published in 1866. The examples thus brought together suffice, at least, to show an extraordinary diffusion for this custom.

ENTERTAINMENTS IN CHEMISTRY: Easy Lessons and Directions for safe Experiments. By HARRY W. TYLER. Chicago: The Interstate Publishing Company. 16mo. Pp. 79. Price, 60 cents.

THIS is another volume in the "Educational Series" published by the Interstate Publishing Company, and referred to elsewhere in these columns. The author gives a number of experiments that can be readily performed with very simple apparatus and a few cheap chemicals. His choice of subjects covers a wide range: thus, for instance, in one chapter he relates the history of a candle, in another he tells about the chemistry of yeast, in a third he treats of combustion and explosion, and in a fourth of soap. The book is well and entertainingly written, and the experiments for the main part well chosen. It seems to us, however, that in a book of this kind the experiments with hydrogen might have been better omitted, because it is questionable whether, even in the hands of a more experienced worker, such experiments can be regarded as "safe" ones.

N. W. AYER AND SON'S AMERICAN NEWSPAPER ANNUAL, 1886. Pp. 1010. Price, $3.

THIS publication, now well known, contains full information about the newspapers published in the United States and Canada, the places where they are published, the business enterprises of those places, and their political proclivities, arranged and classified by States and counties in such a way as to be of the most benefit to advertisers, all of which is revised from year to year. The information on which the annual revision is based is collected in

March of each year, and is subject to correction till the first of July, while later information is admitted in the form of advertisements up to the hour of going to press. The publishers believe that the present—the seventh—is an improvement upon any preceding volume; and the information has been more carefully gathered, and is even more trustworthy, than heretofore. There have recently been added to the headings descriptive of States and counties sections showing, from the census of 1880, the number of manufacturing establishments of all kinds at that time, with the amount of capital invested in them, the number of hands employed, and the value of their annual products, while the State headings show, in addition to the summaries of these facts, the amounts paid in wages, and the value of the raw materials used.

THE THEORY AND PRACTICE OF SURVEYING. By J. B. JOHNSON, C. E. New York: John Wiley & Sons. Pp. 683, with Maps and 150 Text Illustrations. Price, $3.50.

THE large field which the word surveying necessarily covers, renders every attempt at bringing all the different materials together in one volume a rather difficult and perplexing task. Theory and practice are, in hardly any other branch of human activity, so closely connected with each other as they are in the execution of surveyor's work, in which the most exact methods and appliances have to be used in order to secure the degree of accuracy which is always desirable, whether the surveying be done for scientific and national purposes or for the protection of private interests.

The volume under review is designed for the use of surveyors and engineers generally, for whom it will be a valuable reference-book; but it is intended especially for the use of students in engineering, who will find it a complete guide in their studies, containing all that should be familiar to them when they enter practical life as engineers or surveyors.

The text is divided into fifteen chapters, with some appendices and tables. All the apparatus described are, when necessary, shown in illustrations. The instruments used by surveyors are described in the first part, the first six chapters being devoted to instruments for measuring distances, instruments for determining directions, instruments for determining horizontal lines, instruments for measuring angles, the plane-table, and additional instruments used in surveying and plotting.

The second part is devoted to the methods which find application in surveying, the separate chapters being devoted to land surveying, topographical surveying by transit and stadia, railroad surveying, hydrographic surveying, mining surveying, city surveying, the measurement of volumes, geodetic surveying, projection of maps, map-lettering, and topographical symbols. The chapters devoted to railroad, hydrographic, mining, and city surveying—the two latter of which the author acknowledges have been contributed respectively by C. A. Russell, C. E., U. S. Deputy Mineral Surveyor of Boulder, Colorado, and William Bouton, C. E., City Surveyor of St. Louis, Missouri—are of special interest even to practiced surveyors, as they treat of special branches of surveying, about which little, if any, mention is ever made in books for the use of students.

What may be called the scientific part of surveying—geodetic surveying—is fully treated and made comprehensible to those whose purpose is not to devote themselves to geodetical work exclusively, but who have, all the same, to be familiar with the scopes and purposes of geodetical measurements, as every engineer and surveyor has to be.

Of the appendices, one is on the judicial functions of surveyors, by Justice Cooley, of the Michigan Supreme Court; the second is a copy of instructions to United States Deputy Mineral Surveyors for the District of Colorado (1886), while two others contain derivations and formulas. A number of tables for easy reference and for practical use are added at the end.

Three plates accompany the text. One is an isogonic chart of the United States, containing all the data accessible up to 1885, reduced from the United States Coast Survey Chart; Plate II contains all the conventional signs for topographical maps; and Plate III is a topographical practice survey executed by the sophomore class in the Polytechnic School of Washington University. The author is Professor of Civil En-

gineering in Washington University, St. Louis, Missouri. As a whole, this "Theory and Practice of Surveying" will be found a very acceptable addition to the literature on the subject. It will be of great value to the student, who will find through it, and in a readable form, access to information which was formerly only attainable in separate books by different authors.

THE TOWN AND CITY GOVERNMENT OF NEW HAVEN. By CHARLES H. LEVERMORE. Baltimore: N. Murray. Pp. 103. Price, 50 cents.

THIS is one of the "Johns Hopkins University Studies in Historical and Political Science." The incorporation of New Haven city was achieved in the face of no little opposition, and was wrought out through friction between several strongly defined elements in society. The process is nearly the same as that which all towns have to go through in the course of their development, and Professor Levermore's tracing of it through its several steps may be regarded as an illustration from an example typical in many respects, and as a study in a normal course of municipal evolution. The first aspect presented is that of the jealousy between "town-born" and "interlopers"; then the commercial spirit is introduced through the activity of the interlopers. The first phases of city politics are sketched in the distinctions of Patriot and Tory marking the division-lines at elections. The first municipal charter was obtained in 1784, and after that came question after question to be debated, voted upon, and decided. The charter of 1869 marked a culminating point in the constitutional development of the municipality. Previous to that time it had been a more or less thriving, overgrown village. The gradual growth of municipal power exhibited in succession many slowly shifting phases, but a typical, fundamental conservatism could be discerned. Through their nearly two hundred and fifty years of life, the town and region of New Haven have preserved a local character—a well-defined individuality, separate from those of other old colonial centers. Political affiliations have strengthened rather than diminished its exclusiveness. The rivalry between New Haven and Hartford means much more than commercial competition between two urban populations. It is the contention of regions rather than of cities. It is traceable through the whole history of the State back to the charter quarrel of 1662–'64, when one colony was pitted against the other. The dependence of the former New Haven Colony upon New York, which geographical location necessitated, was encouraged by successive animosities; and, "if a line be drawn diagonally across the State from the northwest corner to the mouth of the Connecticut River, the towns and cities to the west of that line are found to rest upon New York as an economic and social basis, just as those upon the east side derive their inspiration from Boston. Of the former of these tracts, New Haven is the capital; of the latter, Hartford. This division of influences should be borne in mind when we read that, in the Revolution, New Haven and Fairfield Counties contained many Tories, while the eastern part of the State was almost unanimously patriotic; that a Windham County mob forced the New Haven stamp-distributor to resign in 1765; and that, one hundred years later, it was, as usual, the Hartford end of the State—the eastern counties—which held the State firmly for Nation with a big "N," and neutralized, by steady and large majorities, the conservative, oligarchical, and pseudo-democratic tendencies of Southwestern Connecticut."

HOUSE-PLANTS AS SANITARY AGENTS: OR, THE RELATION OF GROWING VEGETATION TO HEALTH AND DISEASE. By J. M. ANDERS, M. D. Philadelphia: J. B. Lippincott Company.

DR. ANDERS makes an apology for adding to the number of books, on the ground that he is working in "a branch of scientific literature which, in the form of a book, has not hitherto found an exponent." The apology is not necessary; the book fully justifies its appearance. The purpose of the volume is to set forth, in plain terms, the latest light regarding the effects of some of the various physiological functions in plants and flowers upon the atmosphere in general, and the air of dwellings in particular, as well as the application of this knowledge to the laws of health. Most of the conclusions put forward have been arrived at from

the results of an almost continuous series of personal experiments extending over a period of eight years. These conclusions are —to sum them up into one—that plants and flowers, particularly when cultivated indoors, are worthy to be placed in the foremost rank of sanitary agencies. Further, "the mass of evidence at hand relating to the subject, in the author's opinion, establishes the complete efficacy of living plants as preventive measures in that deadly malady, consumption of the lungs, as well as the signal services they are capable of rendering in certain other conditions of disease." We do not understand the author as recommending in-door life among flowers at the expense of out-door life—if he did, we should differ with him decidedly—but as holding flowers up as a valuable sanitary element of in-door life, and as a substitute, so far as they may be a substitute, for out-door life to those who are not able to enjoy it. A chapter is added on the practical cultivation of plants in the house; and the last chapter is devoted to the consideration of the "Sanitary Influences of Forest Growth." We have to thank Dr. Anders that he has not made his book by dumping into it the magazine articles he has written on the subject, as it is too much the fashion to make books now, but that he has written it all out afresh, in harmonious arrangement, and has thereby given us a compact, symmetrical treatise.

GEOLOGICAL SURVEY OF ALABAMA. By EUGENE A. SMITH, State Geologist. Bulletin No. 1. Tuscaloosa. Pp. 85, with Nine Plates.

THE "Bulletin" comprises two monographs, the first being a preliminary report on the tertiary fossils of Alabama and Mississippi, by Truman H. Aldrich, and the other "Contributions to the Eocene Paleontology of Alabama and Mississippi," by Otto Meyer. Mr. Aldrich's paper is the first installment of a work which is designed to be a complete account of the paleontology of the tertiary formation in Alabama. In preparing it, the author has personally gone over the greater part of the ground, and has collected a large part of the material himself, so that he has been able to give to each species both its locality and its exact place on the stratigraphical scale. The work is, therefore, not a bare description of species, but it illustrates very fully the distribution of the species both in time and space. To it Dr. Smith adds a summary of the lithological and stratigraphical features and subdivisions of the various deposits which make up the tertiary formation in Alabama. In Dr. Meyer's paper a number of new or previously unfigured species of invertebrates are described and figured, and a very few known species are refigured for some special reasons. The type specimens of the fossils are in the author's collection.

REPORT OF THE UNITED STATES NATIONAL MUSEUM, UNDER THE DIRECTION OF THE SMITHSONIAN INSTITUTION, FOR THE YEAR 1884. Washington: Government Printing-Office. Pp. 458.

THIS report constitutes Part II of the Report of the Board of Regents of the Smithsonian Institution. A clear account is given in the report of the assistant director of the organization, administration, and arrangement of the museum collections. In the account of the function and aims of the museum, reference is made to the attitude occupied by some special investigators who are disposed to neglect the claims of the educated public to the enjoyment and instruction which museums afford, and demand that those institutions be administered for the benefit solely of persons engaged in research, as the manifestation of a spirit which defeats its own purpose. "The experience of Europe with its magnificent educational museums, and the history of the several expositions in the United States, should be quite sufficient to satisfy any one who has studied the matter that the museum is an educational power even more influential than the public library." The show of specimens in the cases was, in the year covered by the report—and presumably still is —but a feeble index to the richness of the collections, for "the development of the exhibition series is necessarily slow, since it is not considered desirable to place on exhibition specimens which are not fully explained by printed labels. . . . The extent and nature of the work of the museum are not appreciated by persons who are not familiar

with the character of the laboratory-work, and who have not access to the reserve stores. In the various departments of ethnology and industrial art, for instance, the wealth of the museum is exceedingly great, but, until cases have been built and labels printed, it is impossible properly to display it." But the museum is expected, as this work advances, to improve rapidly in attractiveness to the visitor and general student, and in convenience to the investigator and special student. Besides the general report and review of the year's work in the scientific departments by the assistant director, the special reports of the curators and acting curators of the twenty sections and departments are given: a bibliography of the museum, a list of accessions for the year, and special papers, having much interest, on "Throwing Sticks" and "Basket Work of the North American Aborigines," by Professor Otis T. Mason; "Eskimo Bows," by John Murdock; "A Spotted Dolphin" and "The Florida Muskrat," by Frederick W. True; and "The West Indian Seal," by Frederick W. True and F. A. Lucas.

ANALYSIS OF THE URINE, WITH SPECIAL REFERENCE TO THE DISEASES OF THE GENITO-URINARY ORGANS. By Professors HOFMANN and ULTZMANN. Translated by T. B. BRUNE, M. D., and H. H. CURTIS, M. D. Second edition. New York: D. Appleton & Co. Pp. 310. Price, $2.

THE favor with which this work has been received in medical circles is attested by the fact that it appeared in three languages during the year of its publication. The present issue is the second edition of the English translation, and contains some additions by the pen of the translators. While the book does not pretend to be an exhaustive treatise on the diseases of the genito-urinary organs, it brings all that is essential for the student and the practitioner. Some of the subjects treated of in the different chapters into which the text is divided, are: the histology of the uninary organs, the urine, reagents and apparatus for the approximative determination of the urine constituents, general diagnosis, diagnosis of the diseases of the urinary apparatus.

Great attention and care are of course paid to the different chemical methods of testing and analyzing the urine and its constituents, and the directions are so clearly given that by attentive study and observance of these the student can speedily become proficient in the execution of analyses and in the interpretation of the results obtained.

Eight colored plates, finely finished, are added to this volume. These are not given in the German edition, but are taken from another work, by the same author, on the "Sediments of the Urine." These drawings are to serve as aids in the microscopic examination of the urine deposits, for the microscope bears a part fully as important as chemical analysis in investigations of this kind.

OILS AND VARNISHES. Edited by JAMES CAMERON, F. I. C. Philadelphia: P. Blakiston, Son & Co. Pp. 376. Price, $2.50.

THIS book, one in a series of technological hand-books, contains essentially the matter given in Cooley's "Cyclopædia" and supplemented from the latest publications. It is intended for all interested in and working with varnishes and oils, and contains a great deal of practical information. After an introductory chapter on the chemistry of oils, the animal, vegetable, and mineral oils are successively considered at length and in detail. Under the head of "Testing Oils" the different physical and chemical tests are given that can be advantageously employed; the latter tests embrace methods for both qualitative and quantitative determinations. Separate chapters are allotted to "Resins and Varnishes," and "Testing Resins." The appendix furnishes some interesting tables of prices in England of oils, tallows, essential oils, resins, and varnishes, and statistics of the quantities and values of oils there imported for some years past.

THROUGH A MICROSCOPE. By SAMUEL WELLS, MARY TREAT, and FREDERICK LE ROY SARGENT. Chicago and Boston: The Interstate Publishing Company. 16mo. Pp. 126. Price, 60 cents.

THIS little hand-book is one of a series which is designed to make young readers acquainted with and interested in the elements of natural science. The enlistment of three authors for the preparation of so

small a volume seems quite formidable, but each takes up a special part of the subject and treats of that.

Mr. Wells discusses the simple outfit needed by beginners in the fascinating study of microscopy, gives suggestions as to proper objects to be studied and their preparation, and tells of some simple experiments that will entertain the young student at home in the winter-time, when snow and storms forbid the seeking of subjects for his study in field and meadow.

Mary Treat tells of some interesting plants and animals whose life-history she has observed and studied under her microscope; and Mr. Sargent's contribution is on "A Home-made Microscope, and how to use it," an article which will be sure to please boys of an inventive turn of mind. Quite a number of illustrations are given, which add considerably to the interest and value of this little treatise.

VAN NOSTRAND'S SCIENCE SERIES. 18mo. 50 cents each. The LUMINIFEROUS ÆTHER. By DE VOLSON WOOD, C. E., M. A. Pp. 121.

HAND-BOOK OF MINERALOGY. DETERMINATION, DESCRIPTION, AND CLASSIFICATION OF MINERALS FOUND IN THE UNITED STATES. By J. C. FOYE, A. M., Ph. D. Pp. 180.

FLOW OF WATER IN OPEN CHANNELS, PIPES, SEWERS, CONDUITS, ETC. By P. J. FLYNN, C. E. Pp. 118.

TREATISE ON THE THEORY OF THE CONSTRUCTION OF HELICOIDAL OBLIQUE ARCHES. By JOHN L. CULLEY, C. E. Pp. 125.

FEW properties of the luminiferous æther appear to have been accurately determined, except that of transmiting light at the rate of 186,300 miles per second, and the ability to convey a definite amount of heat energy from the sun to the earth.

Proceeding from these data, the author of the first book on our list seeks, by a long train of reasoning and considerable figuring, to determine and establish what certain other properties this æther must possess. He comes to the conclusion that its density must be such "that a volume of it, equal to about twenty volumes of the earth, would weigh one pound," that the tension is such "that the pressure on a square mile would be about one pound," and that the specific heat is such "that it would require as much heat to raise the temperature of one pound one degree Fahrenheit as it would to raise about 2,300,000,000 tons of water the same amount.

In the "Addenda" are given extracts from Newton's "Principia," and from the works of Clerk-Maxwell bearing on kindred themes.

The "Hand-Book of Mineralogy" is intended by the author as an aid in determining the minerals found in the United States. It gives briefly the prominent and distinguishing characteristics of the different minerals, and aims at presenting the classifications usually adopted in arranging cabinets.

After a few introductory remarks on the apparatus and reagents needed, and a short chapter on blow-pipe reaction, follows the part devoted to the determination of species. This comprises two tables, the first for the "preliminary examination," the other for the "final examination," by means of which tables the nature of a specimen may be readily and rapidly determined.

The remaining part of the work is given to a description of the species, to the chemical classification, and to a classification by basic elements and ores.

A copious system of cross-references is supplied.

The "Flow of Water in Open Channels" is a book of formulæ and tables designed to save time and work for hydraulic engineers who make use of the formulæ of D'Arcy, Kutter, and Bazin, in preference to the older formulæ. As the former, however, although more accurate, are also as a rule more complicated and more troublesome in their application, a book of this kind, practically a ready method of applying the new formulæ, will probably render the use of them more general and popular.

Two objects are intended to be accomplished by the treatise on the construction of helicoidal oblique arches. In the first place, a clear and concise treatment of the construction is aimed at; and in the second place it is attempted to make plain and simple all problems connected with the theory or construction. The author believes that a thorough understanding of the process of the generation of helicoidal surfaces will remove all difficulties that usually present

themselves to would-be students of this subject, and he therefore devotes the first chapter to a careful consideration of elementary principles. Appended is a brief discussion of logarithmic and ribbed oblique arches. Numerous cuts illustrate the principles explained.

THE MAKING OF PICTURES. TWELVE SHORT TALKS WITH YOUNG PEOPLE. By SARAH W. WHITMAN. Chicago: The Interstate Publishing Company. Pp. 131. Price, 60 cents.

IN this book the writer has undertaken to treat of the principles underlying the various processes of making pictures—oil and water-color painting, etching, wood and line engraving, photography, and the various reproductive processes.

First, the author, herself an artist, seeks to help her young friends to an understanding of what art is, and assist them to recognize that subtile "something" which marks the difference between a mere picture—no matter how well done—and a true work of art.

In this connection she speaks of the great laws that exist in art as well as in morals—which laws must be thoroughly understood and comprehended even by those who would merely *look* at pictures, and speak intelligently of them. Then she tells of the fundamental principles that underlie the different ways of making pictures. No attempt is made to teach how to paint in oil, or how to execute an etching, but the implements necessary are enumerated, and the modes of procedure in each process are sketched in clear, bold outlines.

LECTURES AND ESSAYS BY THE LATE WILLIAM KINGDON CLIFFORD, F. R. S. Edited by LESLIE STEPHEN and FREDERICK POLLOCK. With an Introduction by F. POLLOCK. Second edition. London and New York: Macmillan & Co. Pp. 443. Price, $2.50.

PROFESSOR CLIFFORD was a thinker and philosopher—he can hardly be called a writer except in a subsidiary sense—of the rarest qualities of mind, and some of them unique. He seemed to have the power, to a degree which is seldom exhibited, of grasping comprehensively the most abstruse subjects, seeing into them clearly and deeply, and of expressing himself lucidly and vigorously upon them. No better conception can be gained of the character of the work which he produced, including the pieces which are embodied in this volume, than by taking a few views of the representations of the various sides of his nature as they are given by his friend Mr. Pollock, in the biographical introduction. The picture, as a whole, is a charming study of a man who differed much—in excellences—from others of his kind. Clifford began to attract attention not long after he had entered Trinity College, Cambridge, as a young man of extraordinary mathematical powers, and eccentric in appearance, habits, and opinions, and withal an ardent High Churchman. Mr. Pollock, his fellow-student, was early struck with the "daring versatility of his talk. Even then there was no subject on which he was not ready with something in point, generally of an unexpected kind; and his unsurpassed power of mathematical expression was already longing to find exercise." Being asked for aid in solving some elaborate geometrical theorem, he spoke, appearing "not to be working out a question, but simply telling what he saw. Without any diagram or symbolic aid, he described the geometrical conditions on which the solution depended, and they seemed to stand out visibly in space. There were no longer consequences to be deduced, but real and evident facts, which only required to be seen." This incident illustrates Clifford's theory of what teaching ought to be, and his constant way of carrying it out. He showed great taste for gymnastics, in which his accomplishments "were the only ones in which he ever manifested pride," and when he took his degree he had the distinction of being pointed out in "Bell's Life" as an example of a superior scholar who was also a superior athlete. While preeminently mathematical, he was at various times and in various ways marked out for honorable mention in classics, modern history, and English literature. He was fond of historical reading, but took a poetical or dramatical rather than a scientific view of the subject, and saw events "in a series of vivid pictures, which had the force of present realities, as each came in turn before the mind's eye." He did not care

much, apparently, for the use of language as a fine art, although he had a great appreciation of arrangement and composition; and much of his best work was spoken before it was actually written. He had and exercised an aptitude for acquiring languages, and this probably turned, as Mr. Pollock suggests, on the fact that "a new language is a riddle before it is conquered, a power in the hand afterward; to Clifford every riddle was a challenge, and every chance of new power a divine opportunity to be seized." He prosecuted his studies in college with a view to what he wanted to learn rather than to passing the examinations, and therefore came out second wrangler, when by following the other course he might have been far in advance as first. This pursuit of knowledge for its own sake was the leading characteristic of his work throughout his life. "The discovery of truth was for him an end in itself, and the proclamation of it, or of whatever seemed to lead to it, a duty of primary and paramount obligation. This had something to do with the fascination of his teaching: he never seemed to be imposing dogmas on his hearers, but to be leading them into the enjoyment of a common possession. His affections went out to those whose lines of thought were in sympathy with his, without caring whether they agreed in results or not. Everything he said and did was straightforward; "and this, being joined to subtilty and wide range of vision, became in speculation and discussion a very formidable power. If there was anything for which he had no toleration, it was insincerity in thought, word, or deed. He expressed his own opinions plainly and strongly because he held it the duty of every man so to do; he could not discuss great subjects in a half-hearted fashion under a system of mutual conventions. As for considerations of policy or expediency that seemed to interfere in any way with the downright speaking of truth for truth's sake, he was simply incapable of entertaining them." Hence, and by reason of his charming social qualities, while it was possible to take offense at certain passages in his writings, it was "impossible not to like the man." Such was the man whose peculiar modes of thought are reflected in the essays in this volume. The papers, which are preceded by a few selections from Clifford's letters, are sixteen in number. The subjects are: "Some of the Conditions of Mental Development"; "Theories of the Physical Forces"; "The Aims and Instruments of Scientific Thought"; "Atoms"; "The First and the Last Catastrophe"; "The Unseen Universe"; "The Philosophy of the Pure Sciences"; "Body and Mind"; "The Nature of Things-in-Themselves"; "The Scientific Basis of Morals"; "Right and Wrong: the Scientific Ground of their Distinction"; "The Ethics of Belief"; "The Ethics of Religion"; "The Influence upon Morality of a Decline in Religious Belief"; "Cosmic Emotion"; and "Virchow on the Teaching of Science." The essays on "Types of Compound Statement," and "Instruments used in Measurement," which appeared in the first edition of the book, are omitted from the present one, having found a more fitting place in the volume of "Mathematical Papers," which was published in 1882.

THEORY OF MAGNETIC MEASUREMENTS, WITH AN APPENDIX ON THE METHOD OF LEAST SQUARES. By FRANCIS E. NIPHER, A. M. New York: D. Van Nostrand. 1886. Pp. 94.

THIS hand-book was prepared to supplement the instructions of the Coast and Geodetic Survey; it furnishes information regarding the practical details of a magnetic survey. The discussion on the method of least squares is, as the writer states in the preface, an extension of an article in Weisbach's "Mechanics."

PUBLICATIONS RECEIVED.

McGee, W. J. On the Meridional Deflection of Ice-Streams, pp. 7. The Relations of Geology and Agriculture, pp. 8.

Philosophical Society of Washington. Discussion of "What is a Glacier?" pp. 3. Discussion of the Charleston Earthquake, pp. 8.

Eccles, Robert G., M. D. Drugs and Digestion. Pp. 26.

Wheeler, H. A., and Luedeking, C. Iodine in Blowpiping. Pp. 7, with Plates.

May, Thomas J., M. D., Philadelphia. Some of the Causes of Pulmonary Consumption viewed from a Darwinian Standpoint. Pp. 16.

Sanborn, John Wentworth. The Roots and Stems of Words in the Latin Language explained and illustrated with Examples. Albion, N. Y. Pp. 14.

New York State Reformatory, Elmira. Papers in Penology. Pp. 112.

Walker, Edwin C. Bible Temperance. New York: The Truth-Seeker Company. Pp. 48.

Baker, Walter & Co., Dorchester, Mass. Cocoa and Chocolate. Pp. 168.

Alabama Insane Hospital. Tuscaloosa: Biennial Report, 1885 and 1886. Pp. 50.

Smith, L. R. Personal Existence after Death Improbable. New York: The Truth-Seeker Company. Pp. 32.

Illinois State Board of Health. Report on the Water Supply and Sewage Disposal of Chicago. Pp. 16.

Egleston, Melville. The Land System of the New England Colonies. Baltimore: N. Murray. Pp. 66. 50 cents.

Crooker, J. H., Madison, Wis. Unitarians as Congregationalists. Pp. 21.

Whitford, O. B. A Masonic Vindication of Right, pp. 36. The Origin of the Christian Bible, pp. 95. New York: The Truth-Seeker Company.

Heilprin, Angelo. Explorations on the West Coast of Florida and in the Okeechobee Wilderness. Philadelphia: Wagner Free Institute of Science. Pp. 127.

New York Association for Improving the Condition of the Poor. Report for 1886. Pp. 87.

Biological Society of Washington. Proceedings, July, 1884, to February, 1886. Pp. 136.

Society for the Promotion of Agricultural Science. Proceedings at Buffalo Meeting, 1886. Pp. 83.

Lloyd, James Hendrie, Philadelphia. Moral Insanity. Pp. 17.

United States Bureau of Education. The Study of Music in Public Schools. Washington: Government Printing-Office. Pp. 78.

Agricultural College of Michigan. Lessons on Growing Forest-Trees. Pp. 6.

Writings and Services of the Founder of Christian Science. Boston: Hanover P. Smith. Pp. 52. 25 cents.

Chamberlin, T. C. An Inventory of our Glacial Drift. Pp. 20.

Valin, M. D. The American Journal of Biology. Quarterly. November, 1886. Pp. 42. $1 a year.

Brinton, Daniel G. The Conception of Love in some American Languages. Pp. 18.

Modern Language Association of America. Proceedings, 1884–1885. Pp. 250.

McCalley, Henry. On the Warrior Coal-Field. Geological Survey of Alabama. Montgomery, Ala. Pp. 571.

Philbrick, P. H. Beams and Girders. New York: D. Van Nostrand. Pp. 159. 50 cents.

Wells, David A. A Study of Mexico. New York: D. Appleton & Co. Pp. 254. $1.

United States Fish Commission. Report, 1884. Pp. 1204, with Plates.

Gould, B. A. Resultados del Observatorio Nacional Argentino en Cordoba. (Results of the National Argentine Observatory in Cordoba.) Vol. XIV. Pp. 650.

Fowler, Sada Bailey. Irene; or the Road to Freedom. Philadelphia: H. N. Fowler & Co. Pp. 608.

Laurie, S. S. The Rise and Early Constitution of Universities. New York: D. Appleton & Co. Pp. 293. $1.50.

Heilprin, Angelo. The Geographical and Geological Distribution of Animals. New York: D. Appleton & Co. Pp. 495.

Plato. Talks with Socrates about Life. New York: Charles Scribner's Sons. Pp. 176. $1.

Cope, E. D. The Origin of the Fittest. New York: D. Appleton & Co. Pp. 467.

POPULAR MISCELLANY.

Methods of Arrow-Release.—Professor E. S. Morse, while shooting the bow and arrow with a Japanese friend, was surprised to find that the Japanese practice in handling the weapon was totally unlike ours. He then began collecting data illustrating the various methods of releasing the arrow from the bow as practiced by different races; and in time became convinced that the subject had importance, and the pursuit of it might lead to interesting results in tracing the affinities of past races. He has traced out five or six forms of release, which he classifies as the primary release—with the thumb straight and the forefinger bent, as children practice the world over; secondary release, in which the ends of the second and third fingers are also brought to bear on the string to assist in drawing; tertiary release, in which the forefinger, nearly straightened, is also brought to bear by its tip; Mediterranean release, the oldest historical method and the one prevailing in Europe, in which the arrow is lightly held between the first and second fingers, with the thumb straight and inactive, while the string is drawn back with the tips of the first, second, and third fingers; the Mongolian release, in which the arrow is held at the junction of the thumb and forefinger, the base of the finger pressing it against the bow, and the thumb is protected by a ring; the "irregular release" of the Temiangs of Sumatra; and the "archaic release" of the ancient Greeks. All of these releases have been practiced from the earliest historic times; and each of them, except the primary release, which admits of no variation, has one or more varieties. The two strongest and perhaps equally powerful methods are the Mediterranean and Mongolian; "and it is interesting to note the fact that the two great divisions of the human family who can claim a history, and who have been all dominant in the affairs of mankind, are the Mediterranean races and the Mongolians. For three or four thousand years, at least, each stock has had its peculiar arrow-release, and this has persisted though all the mutations of time to the present day." Prof. Morse remarks, upon the importance of a more systematic study of the methods of

archery and the paraphernalia of the archers than has yet been done, that "the remarkable persistence of certain forms of arrow-release among various nations leads me to believe that, in identifying the affinities of past races, the method of using the bow may form another point in establishing or disproving relationships. By knowing with more certainty the character and limitation of the forms of arrow-release, another clew may be got as to the date and nature of fragments of sculpture representing the hand. The peculiar attitude of the archer might lead to the interpretation of armless statues."

Workingmen's Co-operation Organizations.—Mr. A. H. Dyke Acland, M. P., made some statements in the British Association concerning the operation of workingmen's co-operative organizations. After describing the plans on which the organizations are formed, he said that the result of their operation has been a gradual saving of capital, till there is often more than can be employed in the business; indeed, the difficulty with many societies is too much capital, not too little. The increase in the business of the societies between 1865 and 1885 was from about £3,000,000 per annum to more than £20,000,000 per annum. At the present time productive or manufacturing business of £3,000,000 or £4,000,000 a year, on a large or small scale, is carried on, the capital of which comes mainly from the distributive or retail societies. The two wholesale societies are the property of the retail stores, which have created them for their own convenience for the supply of articles direct to their shops from England and abroad. The English wholesale society like the retail societies has had to refuse capital which its members (that is, the retail stores) would willingly have deposited with it. It has adhered mainly to the work of the merchant, and has done comparatively little in the way of manufacturing. Some of the large stores have erected corn-mills and batteries, and many societies employ tailors, dress-makers, and the like, and some are now begining to rent farms. In the large stores there is a great demand for milk, butter, and agricultural produce. These facts throw light on the questions of the possibility of the accumulation of large sums of capital by workingmen; of the successful utilization of such capital by workingmen in industrial enterprise; and of the improvement of the position of the worker or the lessening of the assumed antagonism of employer and employed in consequence of such successful utilization of capital. In the discussion on Mr. Acland's paper, Mr. Evans, representing the Co-operative Congress Board, said it was remarkable to how great an extent the progress of co-operation coincided with the decline of the influence of socialistic teaching.

The Preservation of Water-Colors.—In a paper "On the Fading of Water-Colors," read in the British Association, Professor W. N. Hartley pointed out that colors consist of mineral substances, for the most part of a stable character, or of organic substances comprising stable colors and unstable and changeable colors. Excepting ultramarine, bodies of the former class may be considered unalterable unless they contain lead or mercury; those of the second class may be considered alterable under certain conditions. The action of light on these two classes of substances, when it is capable of affecting them, is different. On mineral substances the red rays cause oxidation; the oxidizing power decreases as the rays extend more toward the yellow; becomes null in the yellowish-green; is reversed and becomes a reducing power in the blue, and this is intensified in the violet and ultra-violet. On organic substances the action of light is an oxidizing one throughout, continuously increasing in power (except in the green, where it is diminished) through the red and yellow into the violet. The action is not confined to oxidation, for bodies of complex and unstable character may be changed in composition, and, being resolved into more stable compounds, changed in color or rendered colorless. In order to preserve water-color drawings in which delicate yellow and red tints are largely used, they should be kept in a very subdued light, preferably of a yellow tint, such as is yielded by daylight passing through blinds of unbleached linen. The action of the violet rays is from two to three times as powerful as that of the red and yellow, and the dif-

ference between the action of diffused daylight sufficient to view pictures and of direct sunlight is at least forty times as great, and in summer probably four hundred times. Hence a picture which would fade in ten years in sunlight might be preserved for something like twelve hundred years in a yellow light. The acidity of drawing-paper should be corrected by a wash of a dilute solution of borax; and in no case ought any paste, gum, or glue, to be placed at the back of a drawing for the purpose of mounting it.

The Mineral Springs of Europe.—Dr. J. Burney Yeo has made a classification of the mineral springs of Europe into groups according to the composition of their waters. The first group includes the simple thermal waters, or "indifferent" springs, the temperature of which is above 80° Fahr. The waters are chiefly used in baths, and, when administered internally, it is simply for getting the purifying solvent influence that might be obtained from drinking pure hot water. They are efficacious in chronic rheumatism, chronic gouty inflammation of the joints, sciatica and other forms of neuralgia; hysterical and hyperæsthetic states of the nervous system; old, painful wounds and cicatrices, and cases of loss of muscular power when not dependent on diseases of the nervous centers. Some of the most popular springs fall under the head of "common salt waters." Their strength varies, and it is customary to fortify them or dilute them, artificially, according as they may need. Used in baths, they stimulate the peripheral vessels and nerves, and promote capillary circulation. They improve the tone and nutrition of the skin, and indirectly stimulate tissue-change. Internally they act as stimulants and indirectly as tonics to the organs of digestion and assimilation; but in persons with highly sensitive mucous membranes they may cause irritation and discomfort, especially if given in too large doses. They are employed in baths in cases of hypersensitiveness of the skin; in some forms of retarded convalescence from acute disease; in scrofulous and inflammatory enlargement of joints; and in chronic hypertrophies of certain organs. Internally they are beneficial in cases of atonic dyspepsia and chronic gastric catarrh, and in those low states of health which are often contracted by prolonged residence in tropical climates. The alkaline waters are characterized by the presence of considerable proportions of carbonate of soda and free carbonic acid in varying amounts, and are exemplified at Vichy. Some of them also contain common salt, when they are classed as muriated alkaline waters, and some, of both simple and muriated springs, are hot and some cold. Many of the springs of this class are found to be most valuable curative agents. The waters are all taken internally, and are used in baths, but not very largely. They are applicable to the treatment of a great number of chronic maladies. In moderate doses they are solvent and purifying, correct acidity, promote tissue-change, and possess active diuretic properties. If taken too largely, they depress the heart's action and cause emaciation. They are given in cases of acid dyspepsia; in gouty constitutions; in cases of renal calculous disorders and gravel; in diabetes; and in cases of torpid liver, with tendency to gall-stones, in constitutions which would not bear the stronger aperient waters. They are of service in the treatment of chronic catarrh of the bronchial and other mucous membranes. The waters containing common salt are more tonic and stimulating than the simple alkaline waters. The group of the sulphated waters includes all the best-known aperient waters, which owe their peculiar qualities to the presence of soda and magnesia, singly or combined. Some of the springs contain also carbonate of soda and chloride of sodium, which add greatly to their remedial value. This has led to the subdivision of the group into the simple sulphated or bitter waters—Friedrichshall, Pullna, and Hunyadi—and alkaline sulphated waters—exemplified in Carlsbad, Marienbad, Franzensbad, and Tarasp. The iron or chalybeate waters are the tonic waters. They are valuable in proportion to their purity—that is, to the absence of other solid ingredients—and in proportion, usually, to the amount of free carbonic acid that they contain. A sixth group comprises the numerous and well-known sulphur-springs, both hot and cold, which are freely used for baths. The celebrated Pyrenean spas are nearly all hot

sulphur-springs, and the most famous of them all are those at Luchon, the hottest of which has a temperature of 154°, and requires cooling before it can be used. The seventh and last group consists of the earthy and calcareous waters, which are marked by a preponderance of the earthy salts of lime and magnesia. In baths, their action is much like that of the simple thermal waters. At Contrexéville, they are administered internally for dyspepsia, and in calculous and vesical complaints; but the precise mode of their action is not well understood. Probably much of their efficacy is due to the large quantity of an active solvent, such as hot water, which the patient is induced to consume; and this, Dr. Yeo hints more than once, may be a chief element in the virtue of all the springs.

Land-Waves.—Professor W. Mattieu Williams maintains that the tidal waves, rushes of the sea, and other phenomena of the kind observable in connection with earthquakes, are not affections of the sea, but of the land. It is the land that undergoes the upheaval and depression that are remarked, but which, as observed by land-dwellers and made known to them by changes in the relative level of land and sea, are attributed to the latter. The great Krakatoa wave "swept half-way round the earth without being felt by any vessel out at sea. It was felt badly enough on land, and on land only. The great wave that made such havoc at the earthquake of Lisbon was evidently a land-wave. It was the rising and falling of the land, not of the sea, that buried the solid marble quay of Lisbon. As Lyell says, 'The quay sank down with all the people on it, and not one of the dead bodies ever floated to the surface.' In its place the water is now one hundred fathoms deep." An account is given in "Nature" of June 3, 1886, of a phenomenon witnessed at Stonehaven, where, at intervals, just before and after high tide, without any apparent cause, the water along the coast rose and fell from ten to eighteen inches at a time, the subsidence leaving as much as from fifteen to eighteen feet of the beach dry. The disturbance continued for three hours, during which "there was no wind, and the sea was quite smooth, but the water advanced and retired with a speed equal to the run of a large river during a spate." It was surmised that the phenomenon was due to some eruption or subsidence in the sea-bottom; but, to Professor Williams, "it appears far more probable that an undulation of the coast itself was the cause, the rising of the land causing the recession of the sea, and *vice versa*. A sea-wave, however caused, on advancing over a shallow, sloping bottom with a fall of from ten to eighteen inches in from fifteen to eighteen feet, would break and form a 'roller,' and distinctly show itself as a 'ground-swell.'" Many other mysterious rushings of the sea on the coast may be similarly explained. They demand more careful study than they have received.

The Rocky Mountains.—Describing the British Columbian Rocky Mountains, before the British Association, George M. Dawson remarked that the term "Rocky Mountains" is frequently applied in a loose way to the whole mountainous belt which borders the west side of the North American Continent. The mountainous belt is, however, preferably called the Cordillera region, and includes a great number of mountain systems or ranges, which on the fortieth parallel have a breadth of not less than seven hundred miles. Nearly coincident with the forty-ninth parallel, however, a change in the general character of the Cordillera region occurs. It becomes comparatively strict and narrow, and runs to the fifty-sixth parallel, or beyond, with an average width of about four hundred miles only. This portion of the western mountain-region comprises the greater part of the province of British Columbia. It consists of four main ranges, or systems of mountains, each including a number of component ranges. These mountains are, from east to west, the Rocky Mountains proper, mountains which may be classed together as the gold ranges, the system of the Coast Ranges of British Columbia (sometimes improperly named the Cascade Range), and a mountain system, the unsubmerged portions of which constitute Vancouver and the Queen Charlotte Islands. The system of the Rocky Mountains proper, between the forty-ninth and fifty-third parallels, has an average width of about sixty

miles, which, in the vicinity of the Peace River, on the fifty-sixth parallel, decreases to about forty miles. It is bounded on the east by the Great Plains, which break into a series of foot-hills along its bases, and on the west by a remarkably straight and definite valley occupied by the Columbia, Kootenay, and other rivers. Since the early part of the century the trade of the fur companies has traversed this range, chiefly by the Athabasca and Peace River Passes; but, till the explorations effected by the expedition under Captain Palliser in 1858–'59, nothing was known in detail of the structure of the range. During the progress of the railway explorations a number of passes were examined, and in 1883 and 1884 that part of the range between the forty-ninth parallel and latitude 51° 30′ was explored and mapped in some detail in connection with the work of the Canadian Geological Survey by the author and his assistants. Access to this, the southern portion of the Rocky Mountains within Canadian territory, being now readily obtained by the railway, its mineral and other resources are receiving attention, while the magnificent Alpine scenery that it affords is beginning to attract the notice of tourists and other travelers.

Dr. Le Plongeon's Researches in Yucatan.—Mrs. Alice D. Le Plongeon, who, with Dr. Le Plongeon, has been zealously engaged in exploring the ancient ruins of Yucatan, read a paper at one of the meetings of the New York Academy of Sciences, in 1886, on some of the results of their joint observations. It related principally to the cities of Uxmal and Chichen-Itza. The "Governor's House" at Uxmal is three hundred and eighteen feet long, and is divided into twenty rooms, the two largest of which are sixty feet long, with ceilings in the form of triangular arches. Outside, the cornice above the doorways supports a magnificent entablature, with designs which, according to the author's interpretation, represent the face of the mastodon, and embody facts concerning the foundation of the city, with statues of the founders. North of this building is a palace of one hundred and two rooms, the arching entrance to the court of which bears traces of paint, and various red hands. "Similar imprints are seen in several buildings, because it was customary for those who used or owned the edifice to dip their hands in red liquid and press the palm against the wall to invoke a divine blessing for the house and inmates, and also to denote ownership." All the façades of this building are elaborately ornamented, and each is different from the others. The prevalent ornament is that of the feathered serpent in different attitudes and designs. On one side, at each end of the façade, was a serpent's head, the tail of the other one drooping over it. They had seven rattles, and just above them was an urn-ornament, with a long plume dependent from it. The heads were crowned, and in the distended jaws of the one yet in place there is a bat's head, and in the bat's mouth the face of a woman. A distinction is made between these serpents and the Maya serpent-emblem of the spirit of the universe, which had not rattles, but a dart at the end of the tail, and not feathers, but wings, and here and there something like fins. In what is called a grand castle at Chichen-Itza are many sculptured pillars, and among the figures represented several men with faces in profile, having long beards. One of them was so like Dr. Le Plongeon that the Indians said it was himself who had lived in that place in ages long gone by! It seems that they believe in reincarnation. In another building is a series of mural paintings representing religious ceremonies, domestic scenes, and battles, the figures of which are said to "show a far more skillful hand than those portrayed in the paintings found in the tombs of Egypt." Near here was found what was regarded as a mausoleum, elaborately ornamented with sculptured macaws and leopards and a leopard-sphinx, in the interior of which, at twenty feet below the surface, were discovered a large statue and two urns containing the cremated remains of the prince, to whom the whole was a monument, with articles in jade, chalcedony, and greenstone. The statue was drawn out, but was afterward seized by the Mexicans and taken to the museum at the capital. In another mausoleum, besides the funerary urn, with the manes and talismans and the statue, were found one hundred and eighty-two conoidal pillars, some painted

blue and others red, and twelve serpent-heads, "exquisitely sculptured and painted in bright colors." The decorations on the outside of the building are chiefly representations of the face of the mastodon, and between the eyes of twelve of those faces is a human face surrounded by an aureole, or halo, of life-size. Dr. Le Plongeon claims to have discovered the key to the Maya hieroglyphics, and assumes to interpret all these figures, carvings, and inscriptions, to which he gives definite historical significance. We are not aware that the validity of his theory and interpretations has been critically passed upon.

A "Nearly Perfect" Civil-Service System.—Mr. Gordon Gray has attempted, in the "Fortnightly Review," to estimate the value of the competitive examinations which prevail in the British official service, as it is shown by their workings. His general conclusion is that "we have no sufficient evidence as to the working of open competition in the Home Civil Service, but that in the Indian Civil Service and the army we have a balance of testimony, official and independent, to the effect that the officers selected under it have shown themselves not unworthy of their positions. But as much as this could surely be said for their predecessors. There is no evidence that the new men are superior to the old, no positive evidence even that they are altogether their equals, for their opportunities have been fewer; and it yet remains to be seen whether when the opportunities do come the men will rise to the occasion." Earl Salisbury said in 1874, writing to the Indian Government: "With respect to the principle of competition itself, the evidence you have collected sufficiently shows that it can not be disturbed without injury to the public service. The expressions of opinion which I have received from competent judges in England lead me to the same conclusion. Of its success as a mode of selecting persons fit to serve in the Indian Civil Service there seems to be no reasonable doubt. The ability which it collects is not the same in kind as that which distinguished the servants appointed under the previous system, and there may be truth in the allegation for which some of your officers contend, that under it instances of conspicuous ability are rare. . . . On the other hand, it is generally admitted that if exceptional powers are rarer than in olden times, exceptions of an opposite kind have almost entirely disappeared." Since this was said, wholesome improvements have been introduced into the examinations. Mr. Gray sees defects in the British system, and objects to it that it does not profess to discover the best men "all round," but "only professes to discover those who can pass the best literary examination in a limited number of subjects. Whether these men are inferior or superior to their competitors, in physical and moral qualifications, it neither knows nor inquires. It indeed inquires rigorously into those qualifications to the extent of discovering absolute unfitness, and occasionally a successful competitor at the literary examination is rejected for unfitness under one of these heads, but the test is only one of minimum qualifications. The authorities have only a right of excluding a candidate who fails to satisfy them that he just reaches the minimum; they have no power to give preference to conspicuous merit over mediocrity." Mr. Gray adds that a system of selection which should bring all the three elements—the mental, the moral, and the physical—that compose the human individual into competition, "would indeed be perfect." The civil-service examinations conducted under our Civil-Service Commission are intended to satisfy this requisition. They are not literary, but comprehensive and practical; and they are varied for each position to which they are applied, for the purpose of bringing out the evidence of fitness in the peculiar qualities which it demands; they are, therefore, wisely directed to approach what the author characterizes as a "nearly perfect" system.

Increase of Temperature in Lake Superior Mines.—H. A. Wheeler has made observations of the differences of temperature in the copper-mines of Keweenaw Point, Lake Superior, which, being now among the deepest mines in the United States, present an excellent opportunity for obtaining data as to the rate of thermal increase with descent into the earth. While the usual thermic gradient is from fifty to fifty-five feet

for an increase of temperature of 1° Fahr., exceptional gradients, both higher and lower than this, have been obtained in some places. Measurements were computed in five mines having depths running from six hundred and seventeen feet to nineteen hundred and fifty feet, with distances between rating stations in each about one hundred feet less than the total depth of the mines. The results obtained show that the thermic gradient in this region—the average of the five mines giving ninety-nine feet to the degree—is one of the lowest that has ever been noted. A view to the cause of the low gradient is indicated by the variations between the different mines. Keweenaw Point is a tapering peninsula extending some seventy miles toward the middle of the lake. None of the mines are, consequently, very far from the water; and those nearest to the lake-shore have the lowest gradient, while those farther away have the higher or more rapid rate of increase. Considering the magnitude of Lake Superior, and the fact that only its surface waters change in temperature, while the great body of its deep waters remains at the temperature of maximum density, or about 39° Fahr., the lake appears to act "as a great cold blanket," giving the general coolness to the rocks which has been observed in the region, and preventing the rapid rise of temperature within the depths to which the mines have penetrated, which occurs under normal conditions.

The Mounds of the Canadian Northwest.—In a paper read before the British Association, Mr. F. N. Bell, of Winnipeg, described the sepulchral mounds of the Canadian Northwest. He pointed out that a continuous line of mounds may be traced from the mound-centers of the Mississippi River to Lake Winnipeg. Human remains, much decayed, were found in them, all buried by being placed on the surface under heaps of earth, in which patches of charcoal and ashes frequently occur. One mound had a burned-clay and bowlder floor, similar to the "sacrificial mounds and altars" of Ohio. Ornaments of sea-shells, which must have been fully twelve hundred miles from their native waters, had been found in these mounds. In addition, the author had discovered an ancient camp on the bank of Red River, near a group of mounds. The mounds from Lake Winnipeg down to the Gulf of Mexico were of the same character, and were probably made by one race. Though whites had found great diversity of mortuary customs prevailing among Indian tribes inhabiting that great tract of country, little exploration had yet been made in the Canadian Northwest, which offered a wide and productive field to archæologists. The mounds were very ancient, and were situated in what were the best game districts.

Some Parrot-Stories.—An English paper publishes a number of interesting and some amusing parrot-stories. One of them might help to illustrate the proverb, "When the cat's away, the mice will play." A young couple went away from home for some weeks, leaving the house in charge of the servants and a parrot. After their return, the parrot would repeat, from time to time, "Let's have another bottle—there's no one here to know!" accompanying its words with the sound of the appropriate "plop!" Another story is not unlike it. A Yorkshire gentleman had a fever, and his parrot was taken from the dining-room to the kitchen. During its abode there, of several weeks, it stole the raisins intended for a plum-pudding. The cook in anger threw some hot grease at it and scalded its head. When the master got better, the parrot's cage was taken upstairs again, and the bird, seeing the gentleman's newly shaven head, said, slowly, "You bald-headed ruffian, so you stole the cook's plums!" Some of the stories may throw light on the question whether or not the parrot adapts its remarks to the circumstances. There was a cockatoo that never asked for potatoes except when dinner was on the table, and never said, "Oh, you are a beauty!" except to a child. Dean Stanley, when Canon of Canterbury, had a parrot which, one morning at breakfast-time, got up into a tree and attracted the attention of all the servants, who gathered around it. The canon then came out, when the parrot looked down at him and said in a low but distinct voice, exactly like Stanley's, "Let us pray." It was evidently reminded of the assembling of the servants at morning prayers. A gray parrot was stationed in a nursery, where his

greatest delight was to see the baby bathed. The child becoming sick, the parrot was sent to the kitchen. There, after a time, he set up a terrible cry, "The baby, the dear baby!" All the family rushed down, to find the parrot, in the wildest excitement, watching the roasting of a sucking-pig. A parrot, which was a slow learner, was taught till it could repeat verses, when, if it made a mistake, it would say angrily, "You are no good"; but, if it went on without error, it praised itself. There is considerable difference in the capability of parrots to learn, and in the way they learn. One is taught with difficulty, but remembers. Another picks up everything that is going on, and remembers nothing for more than a few days. Some few learn easily and also remember well. There are parrots which have a better ear for music than for words, and some which will whistle and sing, and not speak. Moreover, the best acclimatized parrot is easily upset by a change of food or attendance, but especially of surroundings.

NOTES.

A SPECIMEN of the *vibikari*, or sacred snake of Japan, in Dr. Stradling's collection at Watford, England, recently gave birth to between sixty and seventy young ones. Some fifty living and still-born snakelets were collected, and it was believed that at least a dozen more had been destroyed by other snakes in the cage. At ten days old the young ones had cast their skins, and were beginning to eat earth-worms and small slugs. These snakes well illustrate the curious provision of a temporary, long, chisel-like front tooth with which baby-snakes are enabled to cut their way through the soft, membranous envelope of the egg. They showed fight as soon as they were born, and were always ready to snap at an intrusive finger. This is the first time this species has bred in Europe.

SIR EMERSON TENNENT long ago called attention to the power of the cocoanut-palm to conduct lightning, and the subject is again called up by a Ceylon paper. Five hundred of these trees were struck on a single plantation during a succession of thunder-storms in April, 1869. But the trees suffer terribly from the effects, for, however slightly they may be touched, they are sure to die. Even if only the edges of the leaves are singed, or only a few of them are turned brown, the tree will in the end wither gradually and perish.

DR. J. STUART NAIRNE, of the Glasgow Samaritan Hospital for Women, has recorded several instances in his practice in which the use of fish, boiled or fried, as food, by patients, even when considerably advanced in convalescence, was followed by evil consequences; and he had begun to believe that, under any circumstances of debility, fish was a very dangerous diet, and forbade its use. Further observation taught him that the fault was not in the fish itself, but in the method of cooking it; and that when steamed, instead of being boiled or fried, it was much more easily digestible and perfectly harmless.

MR. J. STURGEON explained to the British Association a scheme for the introduction of compressed air-power into Birmingham. He showed that although each 1,000 horse-power at the central station may only produce 500 effective horse-power at the user's engines, it will displace fully 1,000 horse-power of small boiler-plants, furnaces, chimneys, etc., and the same engines can be used with compressed air as with steam. The centralization principle permits the use of engines and boilers of large power, with all the modern improvements. At the pressure proposed (forty-five pounds) the air-driven engines will indicate from thirty to sixty-five per cent of the power developed at the main engines, according to the mode of using the compressed air.

THE Rumford Medal of the Royal Society has been awarded to Professor Samuel P. Langley for his researches on the spectrum by means of the bolometer.

SUMMING up the points of an address on "What constitutes Malignancy in Cancer?" Dr. Herbert Snow, of the cancer Hospital, London, expresses the conclusion that the phenomena designated by that term "result from conditions which irritate normal protoplasm, cause it to proliferate abnormally, and to assume a quasi-independent parasitic vitality. These conditions may be mechanical; in a much larger proportion of cases they are neurotic. That is the farthest point we have yet reached; nor do I see how our knowledge of cancer can make much advance until we know far more than at present about the ultimate properties of protoplasm, and the manner in which this is influenced by states of the nervous system."

IT is reported that the state management of railways has proved a practical failure in all those countries where private lines have been allowed to compete with it. Instead of the government regulating the private railroads, as it was expected to do, it is regulated by them, and has had to adjust its terms to meet those which they imposed. In Belgium, the Government rail-

roads, and the canals, also owned by the Government, have had something very like what we call a "railroad-war" with one another. The "mixed system" has been abandoned—in Belgium and Prussia, by state management having been made almost universal; and in Italy by its having been practically given up.

M. A. BULLE, of Besançon, France, has effected the direct electro-chemical deposition of palladium on iron, steel, and other metals. The deposition is made directly and of any required thickness, and constitutes the last process in finishing the manufactured article.

IN a paper read before the British Association, Lord Rayleigh described the method of experiments which he had made for measuring the intensity of reflection from glass and other surfaces, and the results. With a piece of optically-worked blackened glass the amount reflected was .058 of the incident light. The amount of reflection depended greatly on the clearness and polish of the surface. In one case repolishing increased the amount from ·04095 to ·0445. Fresnel's formula gave in this case ·04514. Generally it appeared that the amount reflected was less than according to Fresnel's formula—a result contrary to Rood's. The numbers for polished glass, and for silver on glass, were ·94 and ·83.

THE Uralian Society of Lovers of the Natural Sciences will open a Scientific and Industrial Exhibition of Siberia and the Ural Mountains, at Ekaterinburg, on the 27th of May, to continue till the 27th of September, 1887. The mining and metallurgical enterprises, for which the Ural is famous, will be fully represented; in the ethnographic department, the interesting aboriginal tribes of Siberia will be illustrated by groups of living families, with their habitations, furniture, implements, and costumes; and the archæological collections will be to a large extent composed of objects which have never before figured at an exhibition of the kind. Reduced fares from Nijni-Novgorod will be provided for by the committee, of which Mr. A. Mislawsky is chairman.

OBITUARY NOTES.

M. DUBSC, a distinguished optician of Paris, died in October. He is best known for having assisted M. Léon Foucault in all his constructions, and especially in the organization of his automatic electric lamp.

PROFESSOR PAUL MORTHIER, for twenty-one years Professor of Botany at the Academy of Neufchâtel, Switzerland, has recently died. He studied medicine in his early days, and became a skillful surgeon; then he studied botany under Dr. Oswald Heer; was appointed to his professorship in 1862; was the founder of the Swiss Botanical Society; and was regarded as a high authority on sponges.

M. CHANCOURTOIS, General Inspector of Mines in France, who has recently died suddenly in Paris, was the author of several works on geology, and a professor in the School of Mines.

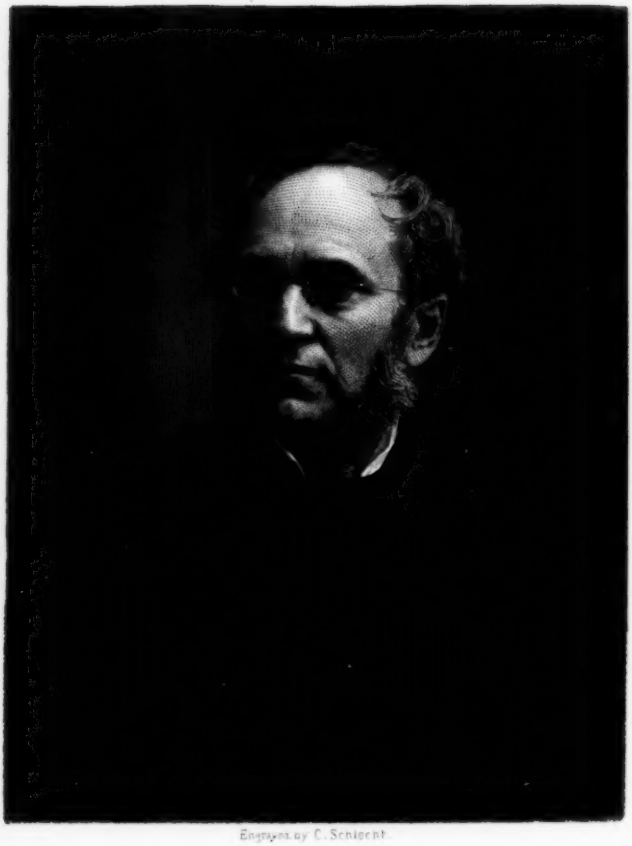
THE death has been reported of Elie Wartmann, Professor of Physics in the Academy at Geneva. He was the author of numerous important researches and books, among which were those on Daltonism (1840), voltaic induction, the simultaneous transmission of dispatches in opposite directions on the same wire, and on electric currents in plants. He contributed largely to the organization and arrangement of the splendid physical cabinet of the University of Geneva.

ALEXANDER BOUTLEROW, a Russian chemist, has recently died, at the age of fifty-eight years. He was a pupil of Wurtz's, and, as a professor at Kazan and afterward at St. Petersburg, was largely instrumental in introducing modern chemical theories into his country. He took part in the foundation of the University for Women at St. Petersburg in 1879. His most important researches were on fatty bodies and the isomerism of the hydrocarbons. His treatise on organic chemistry was translated into German. He was interested in apiculture, on which he wrote some popular manuals, and was a believer in spiritualism, on which he also wrote a book—"Psychical Studies."

M. JULES BOUIS, an eminent French chemist, member of the Academy of Medicine and Professor in the School of Pharmacy, died on the 21st of October, aged eighty-four years. He studied chemistry in Dumas's laboratory; distinguished himself by numerous experiments; and was engaged during a large part of his life in teaching chemistry in various important schools in Paris.

GENERAL JOHN THEOPHILUS BEAULIEU, F. R. S., who has recently died, at the age of eighty-one years, performed a long service in India, beginning in 1820. He was for some time Superintending Engineer in the Public Works Department for the Northwest Provinces; founded the system of magnetic observations in India; and was the author of a book of logarithms.

THE death, at Berlin, is reported of Dr. A. Fischer, who resided for a long time at Zanzibar, and by whose energy much has been added to our knowledge of the Kilimanjaro region



Engraved by C. Schlecht

Sincerely Yours

E. L. Yamans